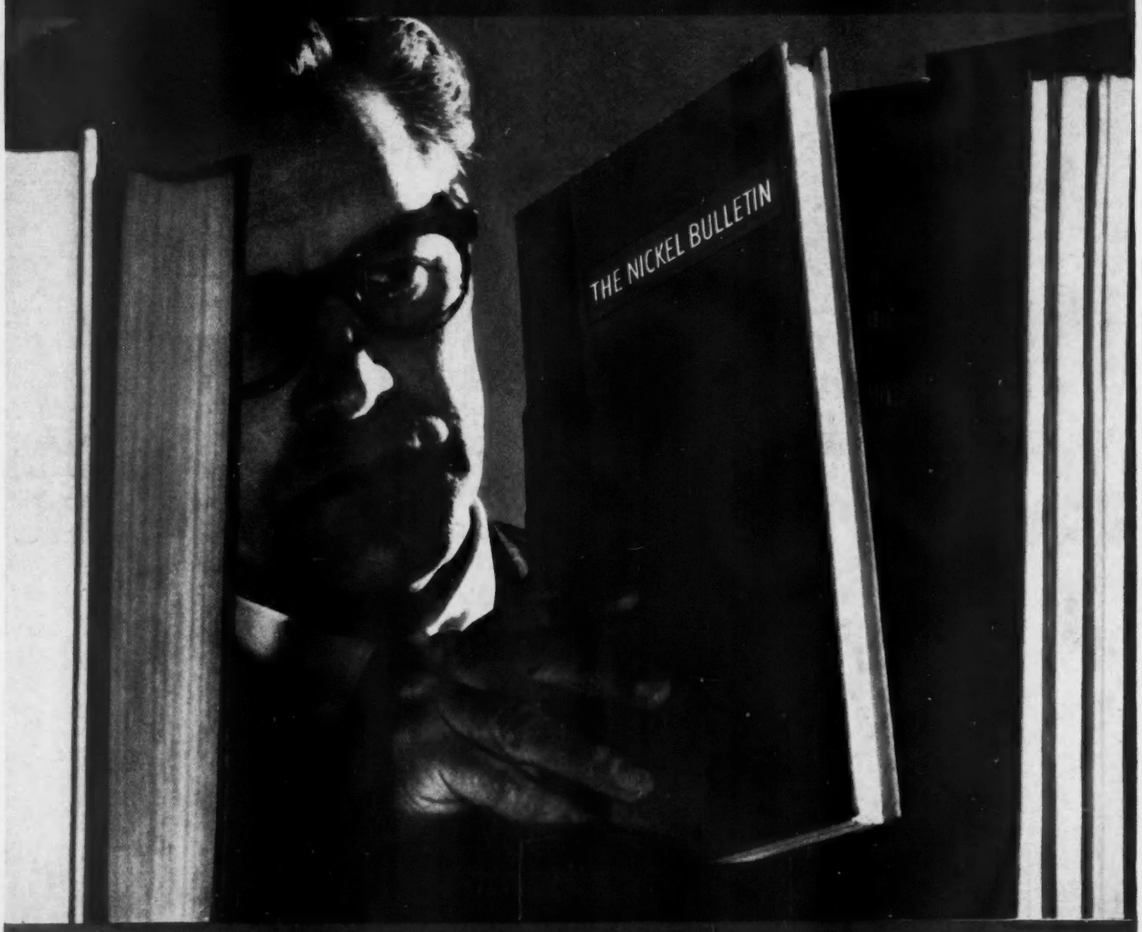
# The Engineer

JUNE 20, 1958 28 ESSEX ST., STRAND, LONDON, W.C.2 TWO SHILLINGS



EVERY PICTURE TELLS A **NICKEL** STORY




He seeks enlightenment—and whether his eyes are on distant projects of research or the daily problems of an industry, his basic needs are the same. Exactness. Facts that work. Ideas that will help him to the goal. If his work involves the choice of metals for new and exacting conditions, sooner or later his search will bring him to nickel. Mond have the resources for research and development and supply technical publications for guidance in the choice and use of modern materials.

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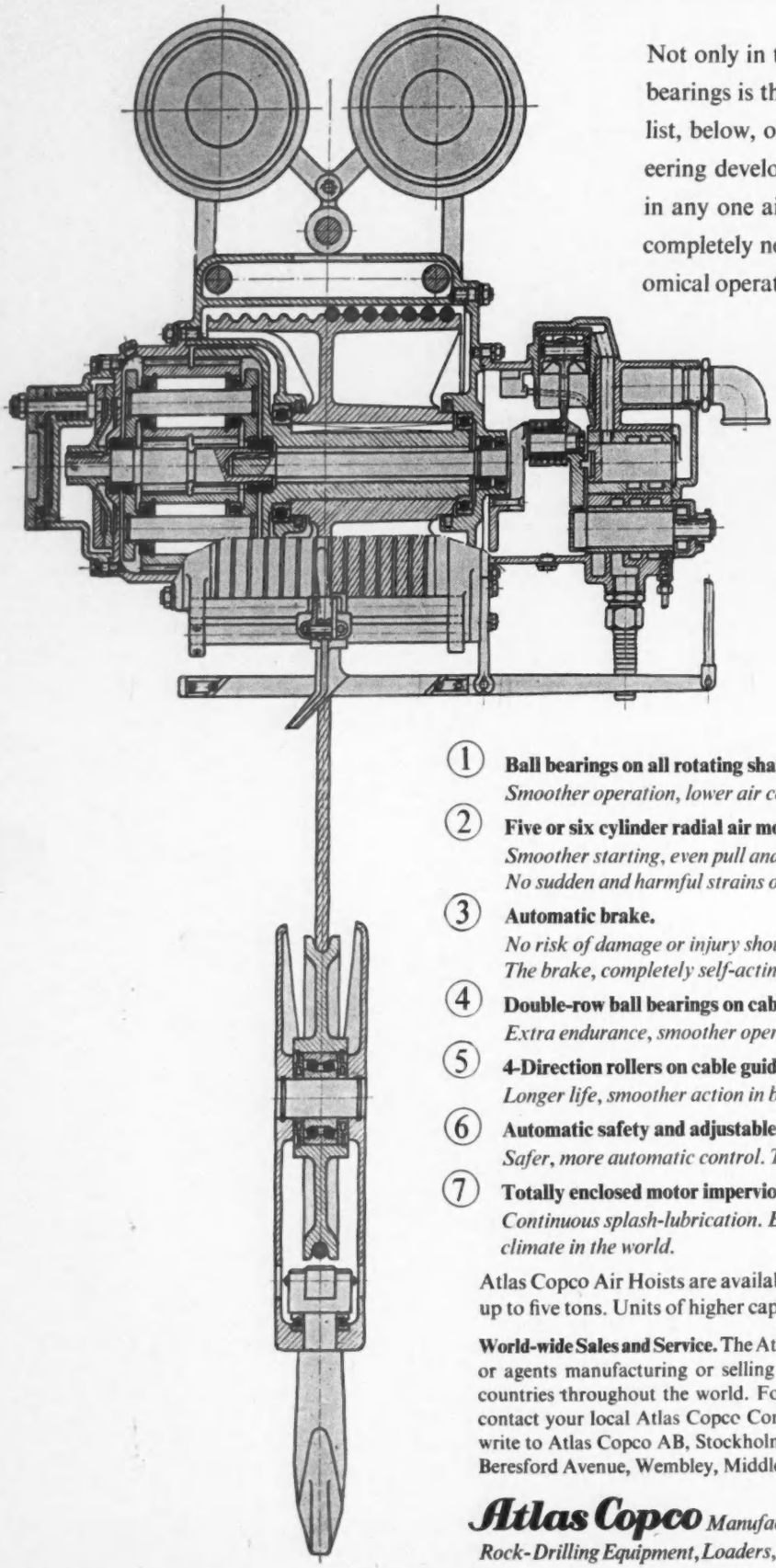
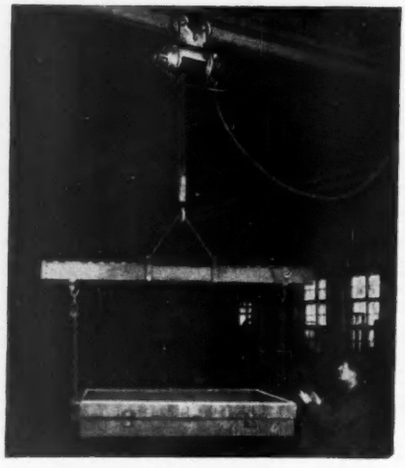
## have ball bearings on all rotating shafts—roller bearings for connecting rods



Not only in this complete application of ball and roller bearings is the Atlas Copco Air Hoist unique. Read the list, below, of seven major features. These tested engineering developments have never before been combined in any one air hoist. Each plays its part in achieving a completely new overall standard of efficiency and economical operation.



① **Ball bearings on all rotating shafts and roller bearings for connecting rods.**
*Smoother operation, lower air consumption, longer service life.*

② **Five or six cylinder radial air motor.**
*Smoother starting, even pull and ultra-sensitive control.*
*No sudden and harmful strains on goods handled.*

③ **Automatic brake.**
*No risk of damage or injury should air supply be interrupted.*
*The brake, completely self-acting, is only OFF when the air pressure is ON.*

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*Extra endurance, smoother operation at this critical point.*

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⑦ **Totally enclosed motor impervious to dust.**
*Continuous splash-lubrication. Efficient, trouble-free operation ensured in any climate in the world.*

Atlas Copco Air Hoists are available in a standard range covering capacities up to five tons. Units of higher capacities can be supplied to special order.

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# THE ENGINEER

*Established* 1856

No. 5343 **JUNE 20, 1958** VOL. 205

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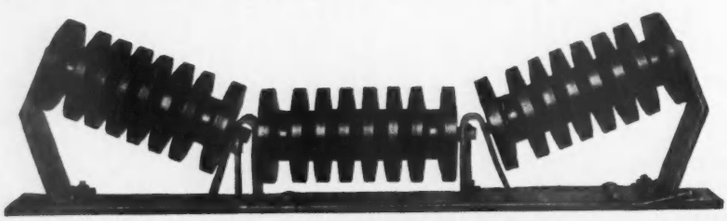

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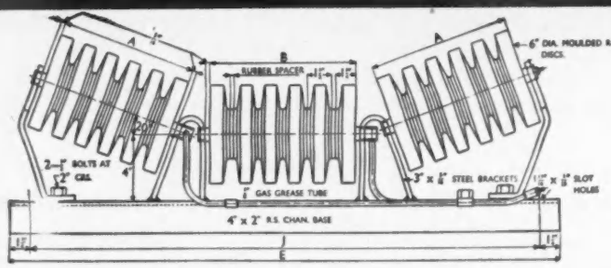


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| 18" .. | 6½" | 7" | 28" | 25⅝" |
| 20" .. | 7" | 8" | 30" | 27⅝" |
| 22" .. | 7½" | 9" | 32" | 29⅝" |
| 24" .. | 8½" | 9" | 34" | 31⅝" |
| 26" .. | 9" | 10" | 36" | 33⅝" |
| 28" .. | 10" | 10" | 38" | 35⅝" |
| 30" .. | 10½" | 10½" | 40" | 37⅝" |
| 36" .. | 12½" | 12½" | 46" | 43⅝" |
| 42" .. | 15" | 15" | 52" | 49⅝" |
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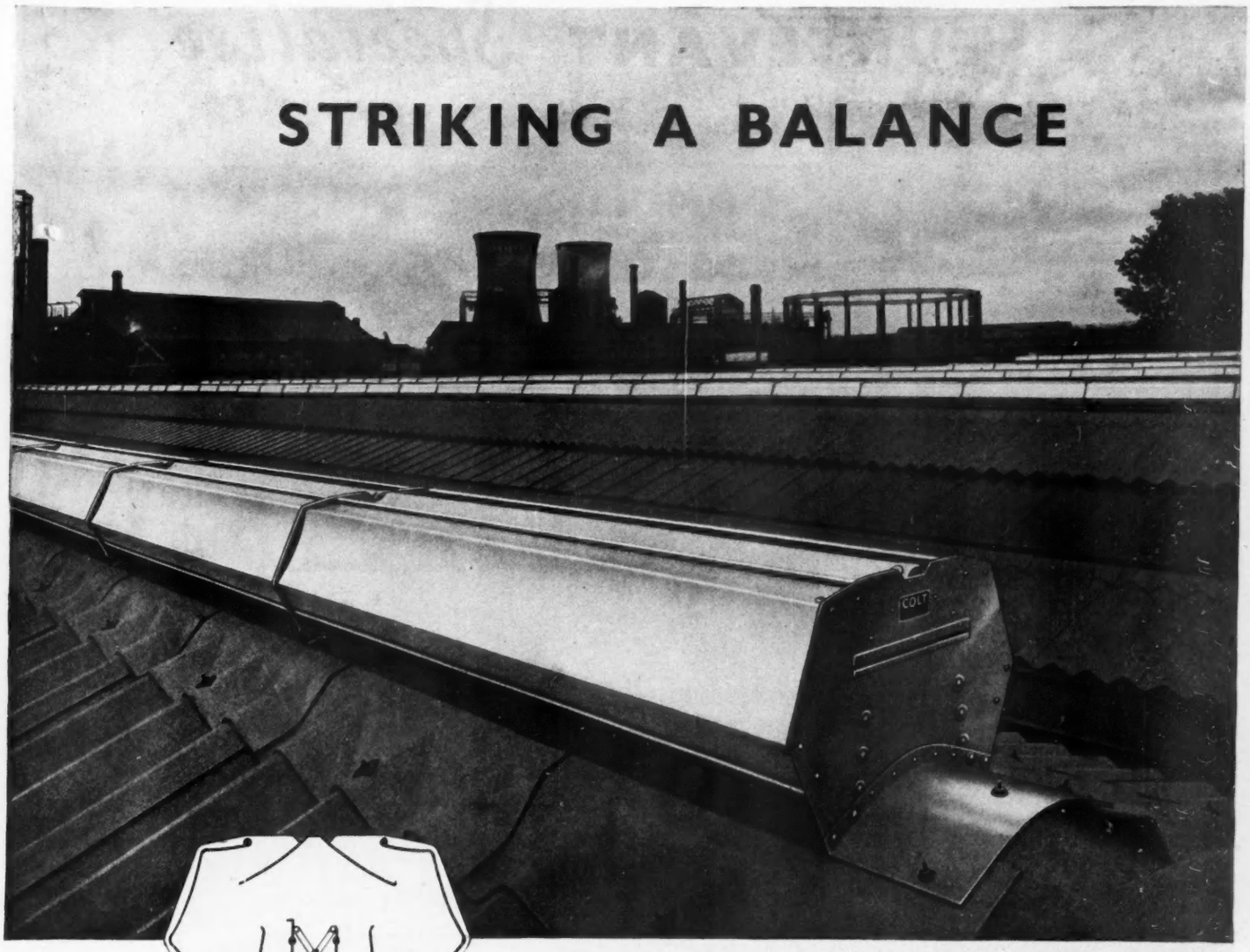


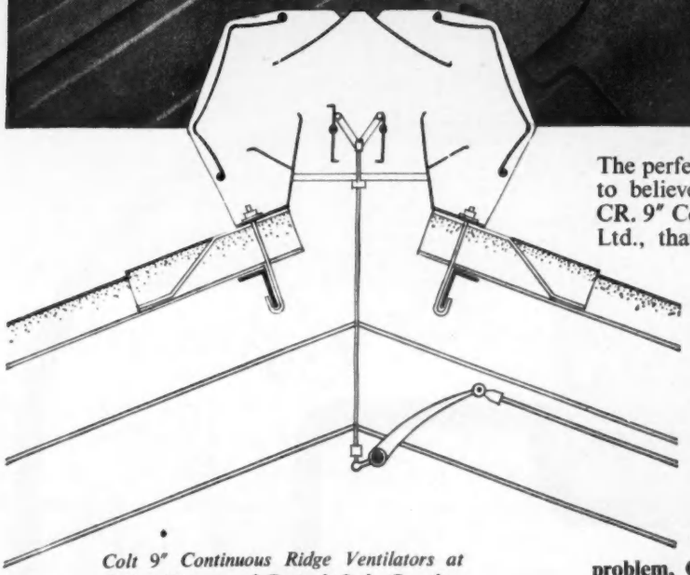

*Colt 9″ Continuous Ridge Ventilators at Bailey Meters and Controls Ltd., Croydon, Surrey. Architect: Reginald Lone, F.R.I.B.A., F.R.I.C.S., F.R.San.I.*

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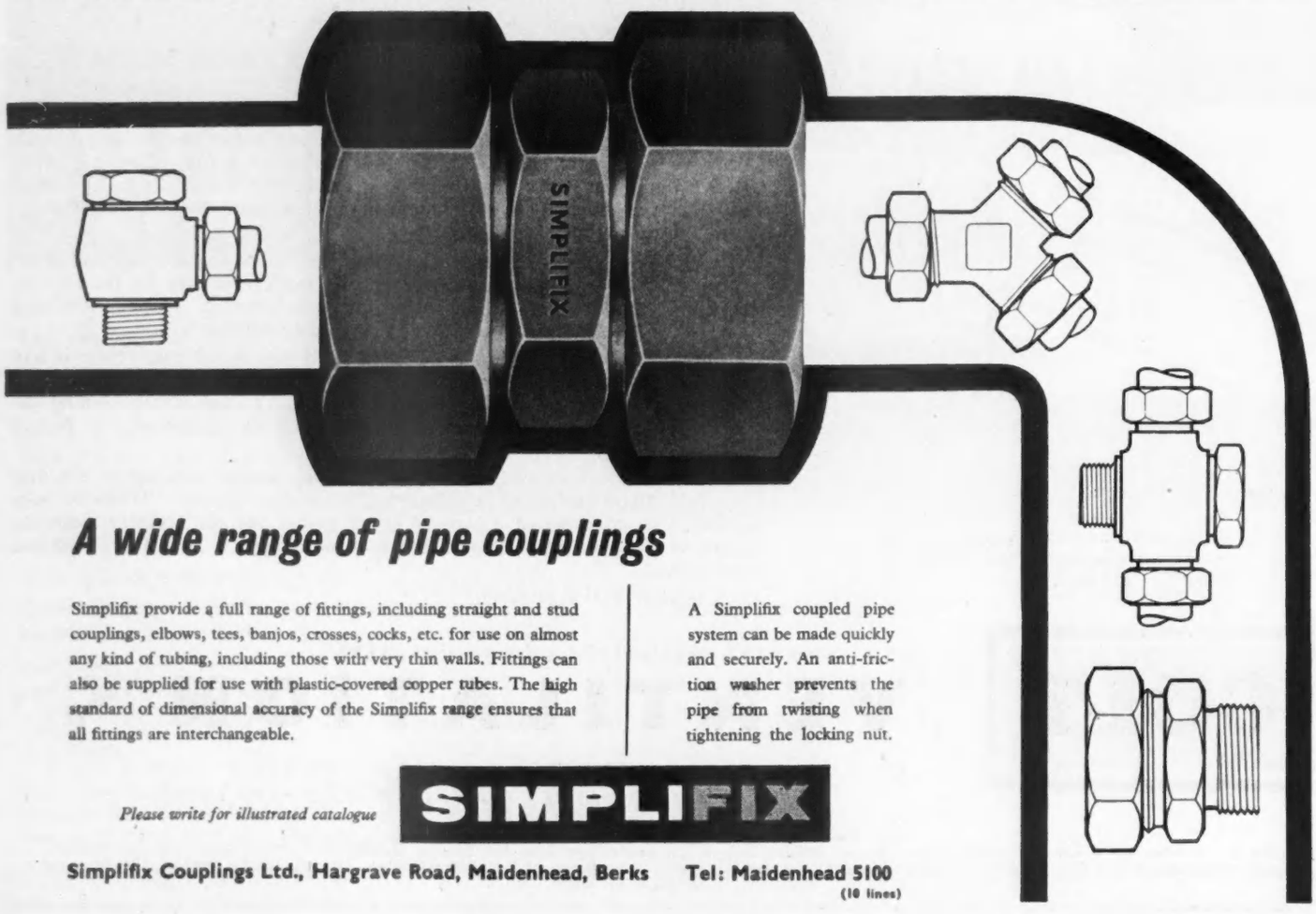


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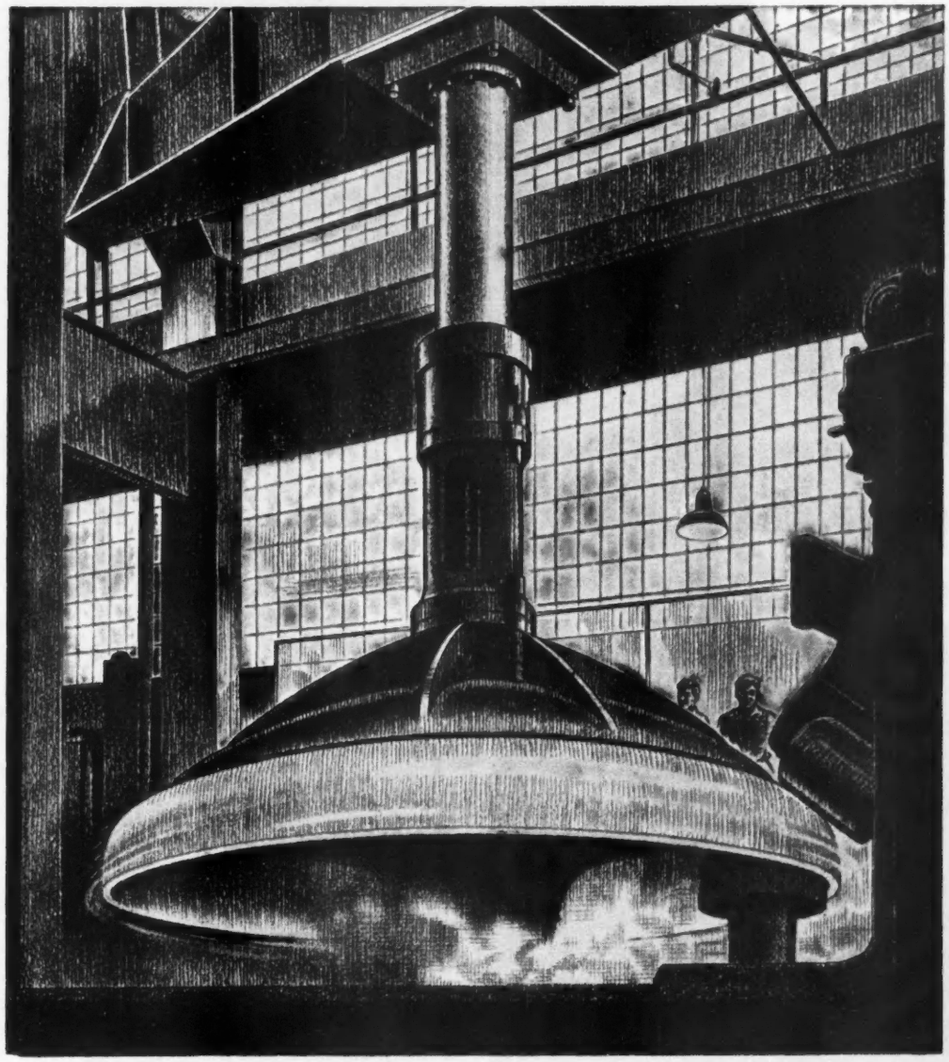

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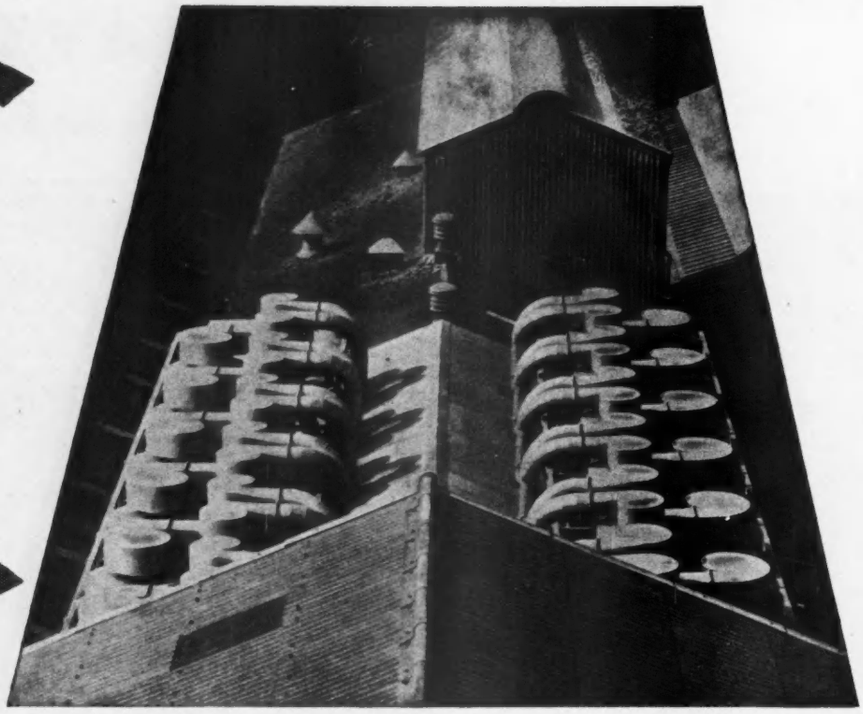

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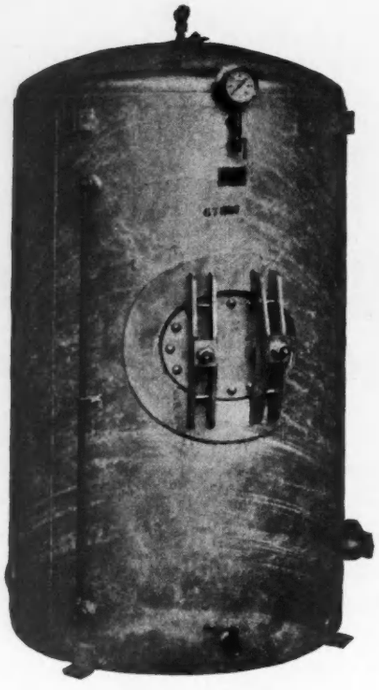

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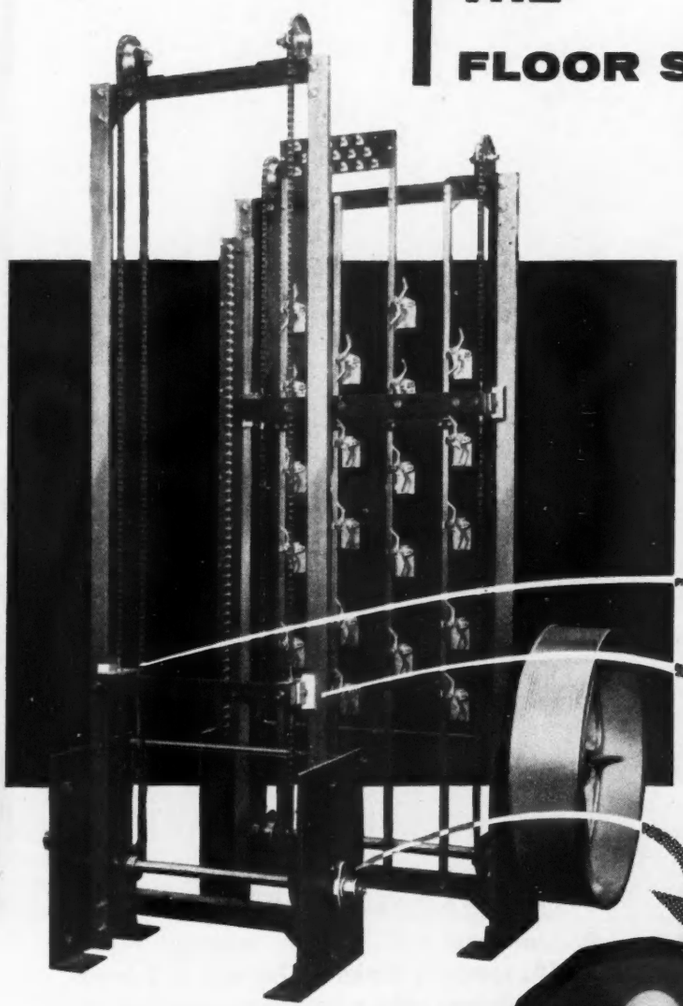

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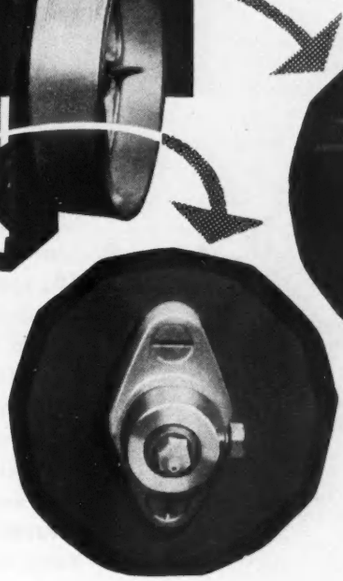
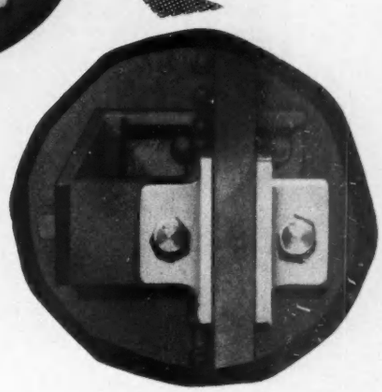


*Plain bearing*

*Slide bearing front view*



*Slide bearing side view*

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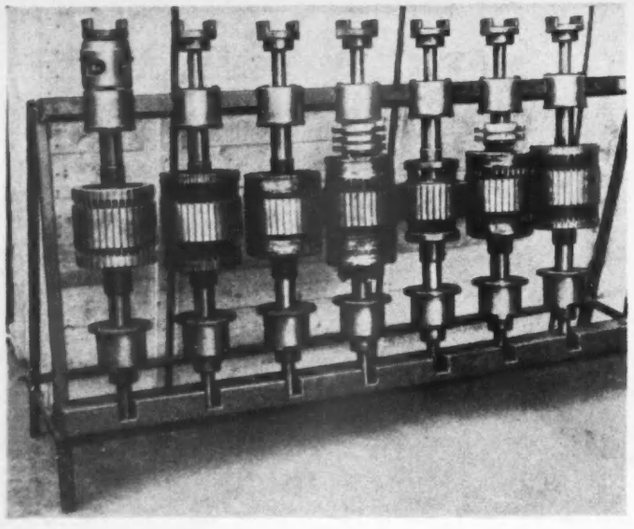

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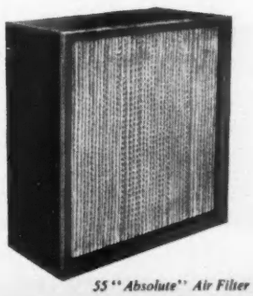

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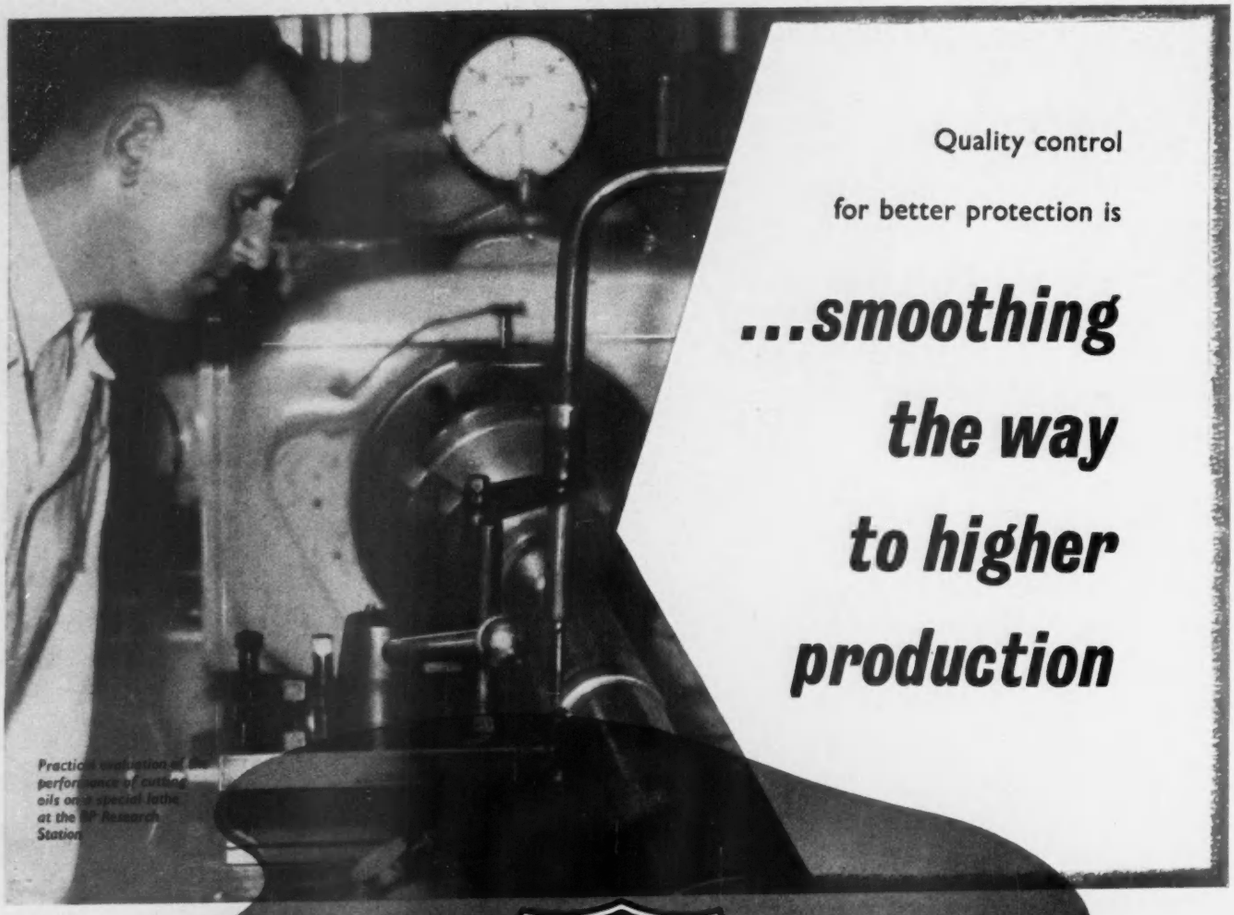


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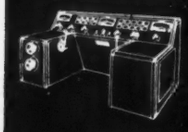

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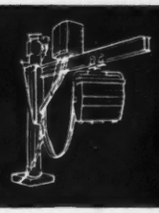

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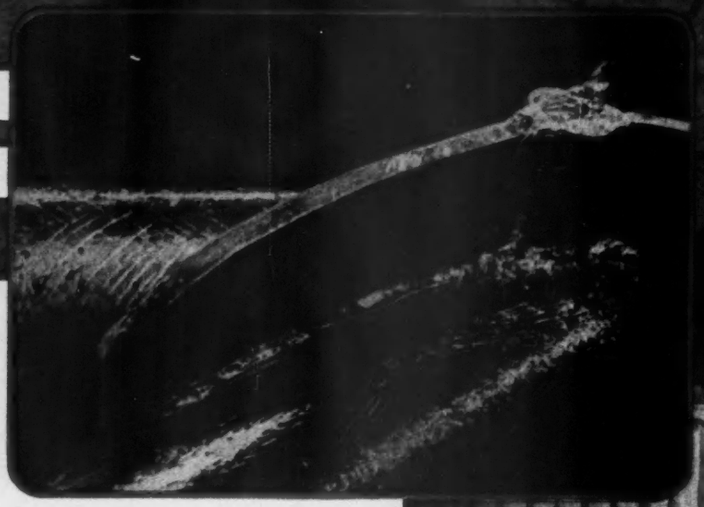

## DESIGN OF BRANCH PIECES

The reinforcement of branch and junction pieces in steel pipes for a long time presented a difficult problem; some years ago our Research department investigated various types in current use and evolved a design of their own which has proved highly satisfactory. This, known as the 'triform' reinforcement, embodies three horseshoes embracing the junction between the pipes.

To test the adequacy of such reinforcements against internal pressure, special testing pumps are in use in our Research department at Corby; these are capable of exerting pressures up to 27,000 lb./sq. inch under sensitive and accurate control.

The illustration shows such a test being carried out on a welded 'Y' piece with a triform reinforcement. Before internal hydraulic pressure is applied the 'Y' piece is coated with plumber's resin. As the pressure increases a stage is reached when small cracks, indicating the presence of Lüders' slip lines in the material, appear in the resin (see insert) thereby showing those points at which yielding has occurred. From the disposition of these slip lines much can be learned about the stresses in the material, and the information obtained leads to efficient and simple designs of adequate strength.

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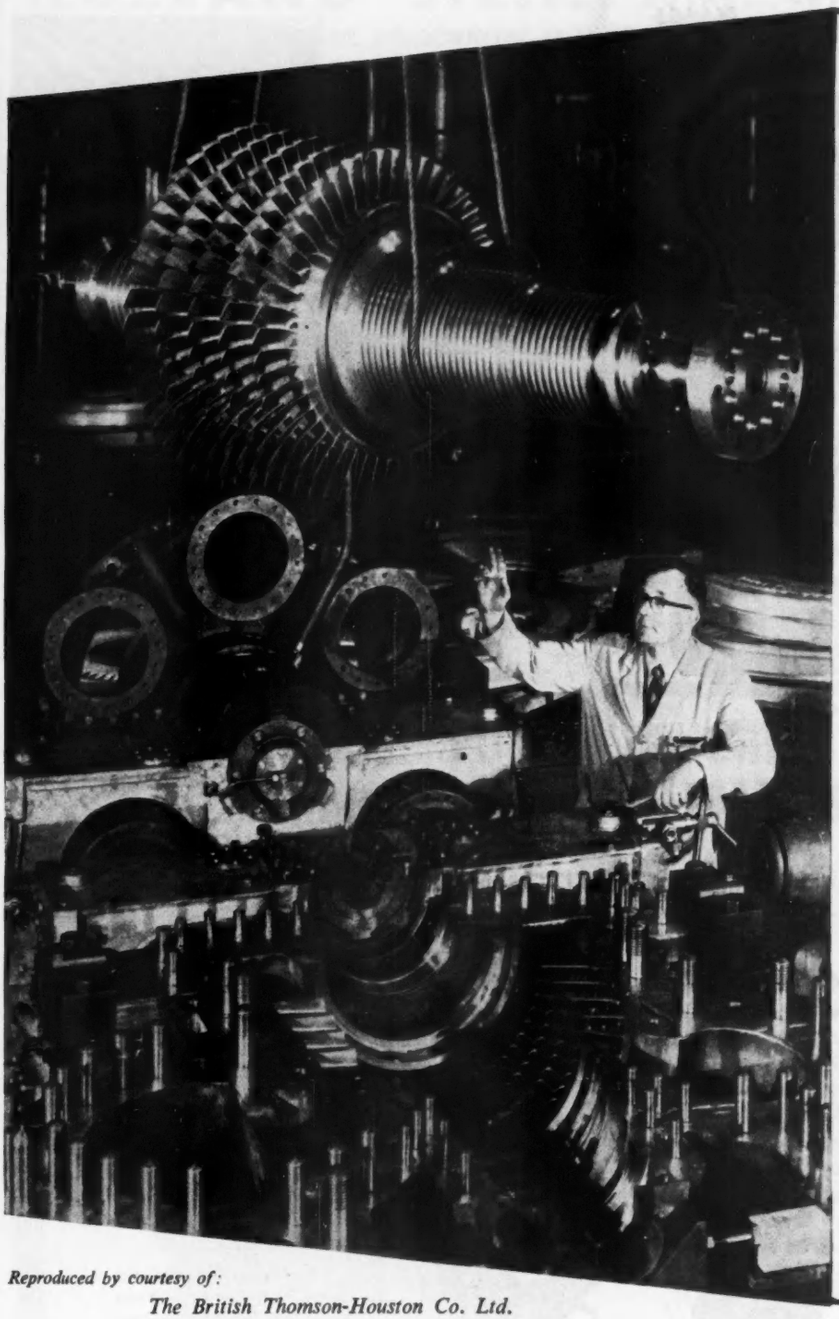

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*The British Thomson-Houston Co. Ltd.*

# Disc and Blade Drop Forgings for the Turbine Industry

by

High pressure turbine rotor for the new 5,500 b.h.p. gas turbine for the Shell Tanker "Auris", the first ocean-going merchant vessel in the world to be fitted with a gas turbine. All the stainless steel and "Nimonic" blades for this rotor were drop forged by Firth-Derihon.

A 16mm Colour Film with sound commentary, entitled "Drop Forgings in Alloy Steels," is available on request.

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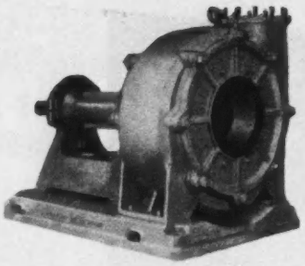

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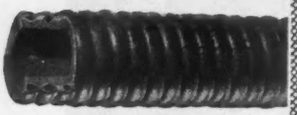

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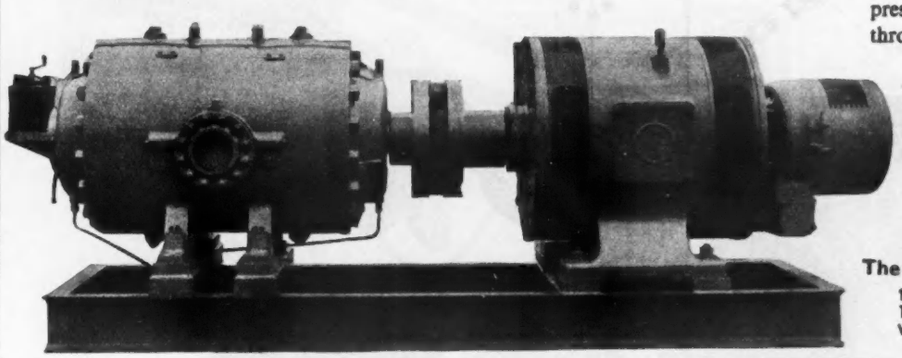

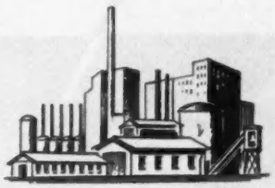

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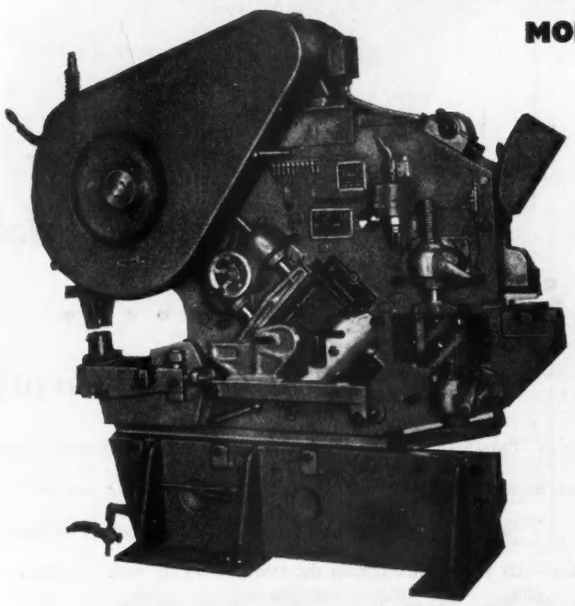

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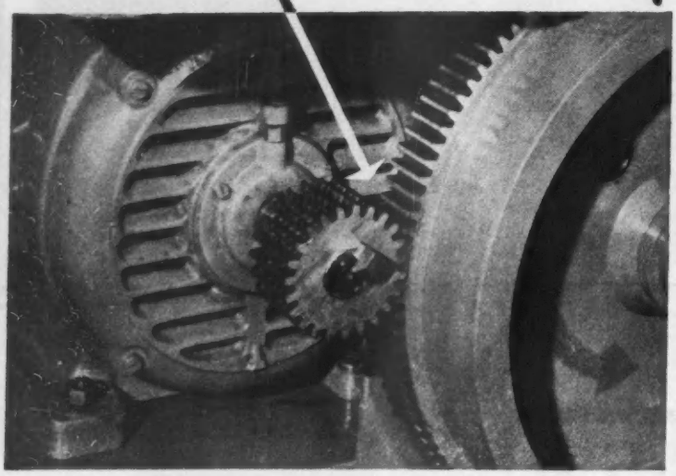

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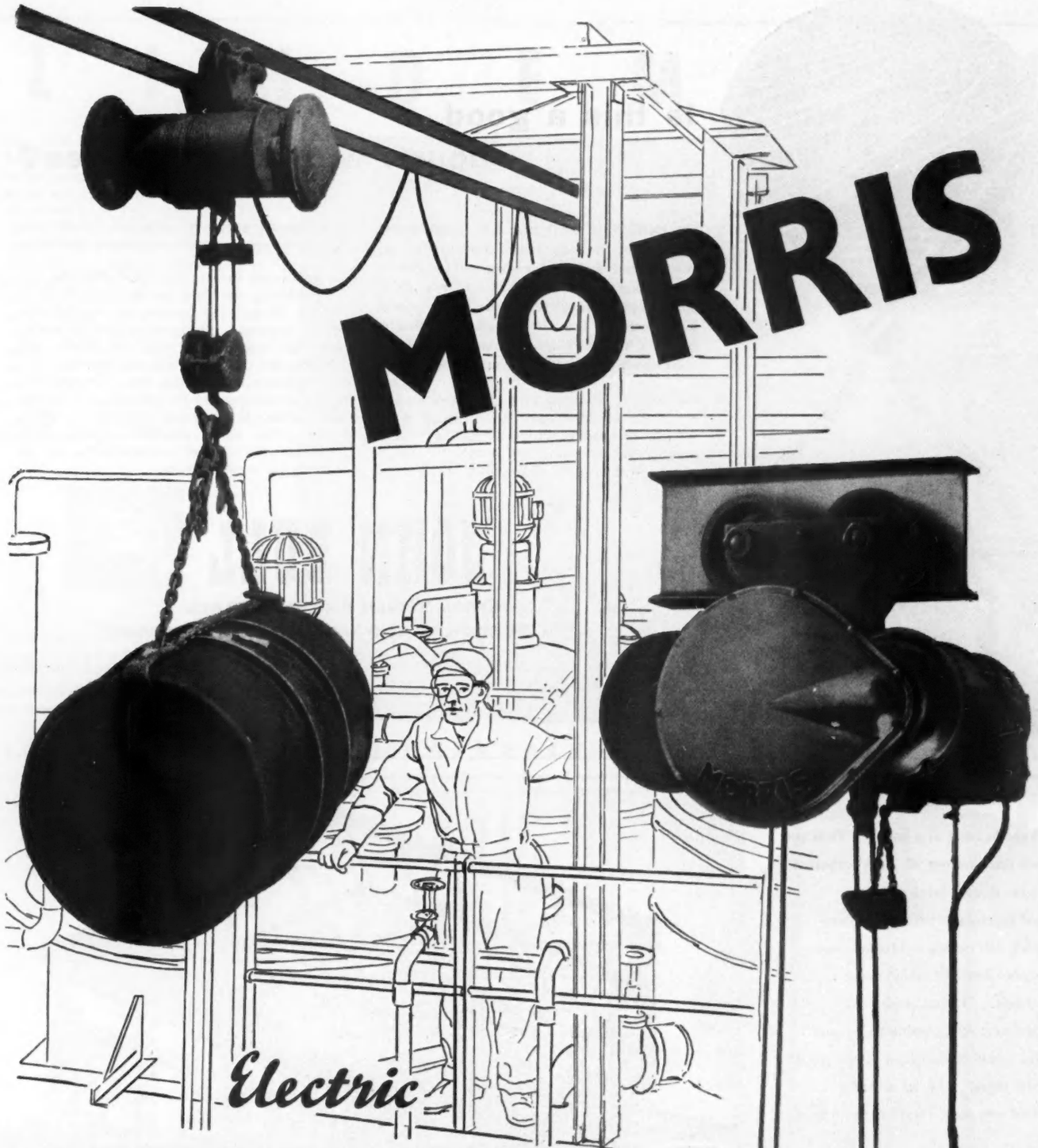


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*Twenty page Section 73 gives more details.*

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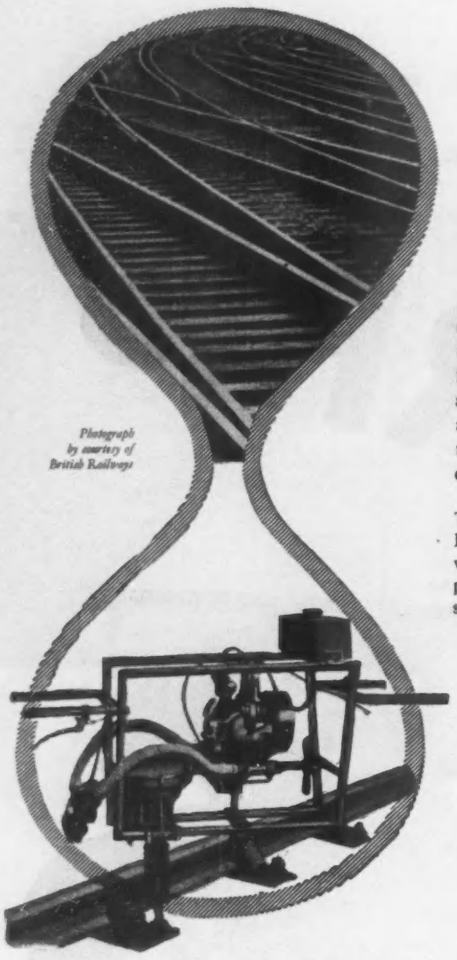

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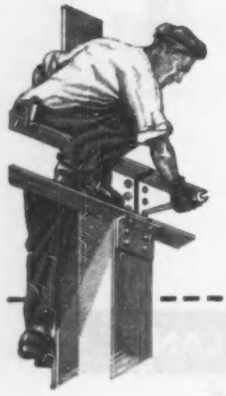

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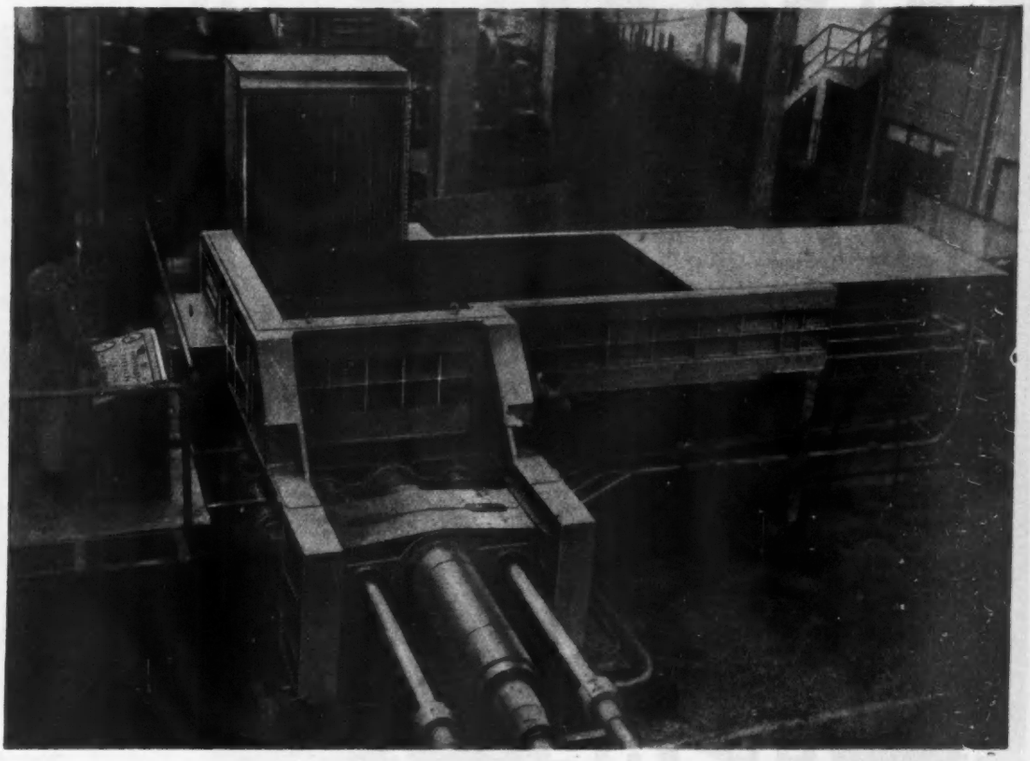

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AP71

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For the South of Scotland Electricity Board

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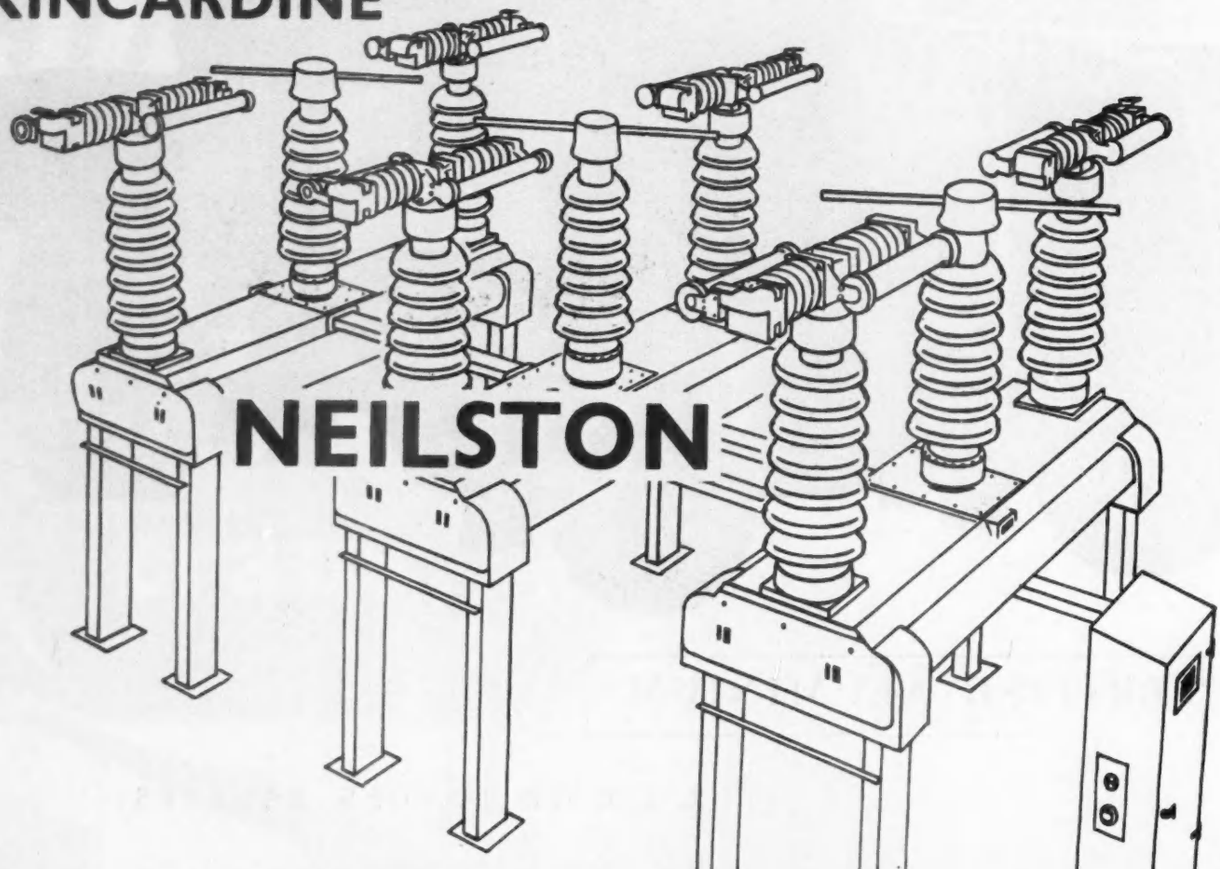

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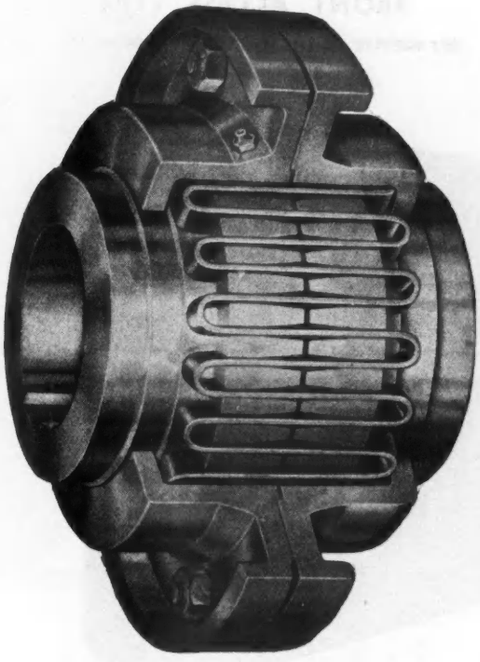

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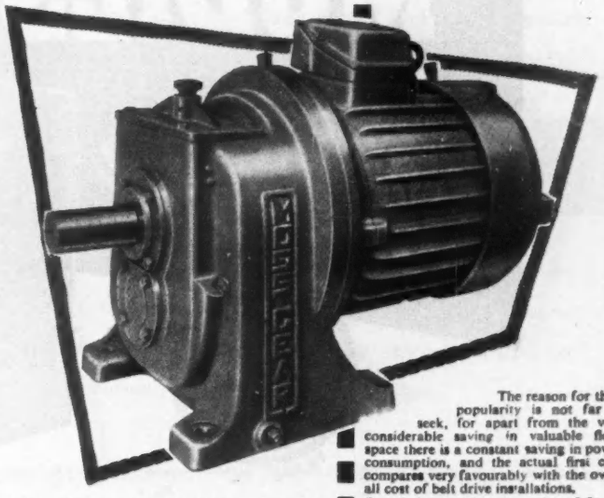

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**BRONX**

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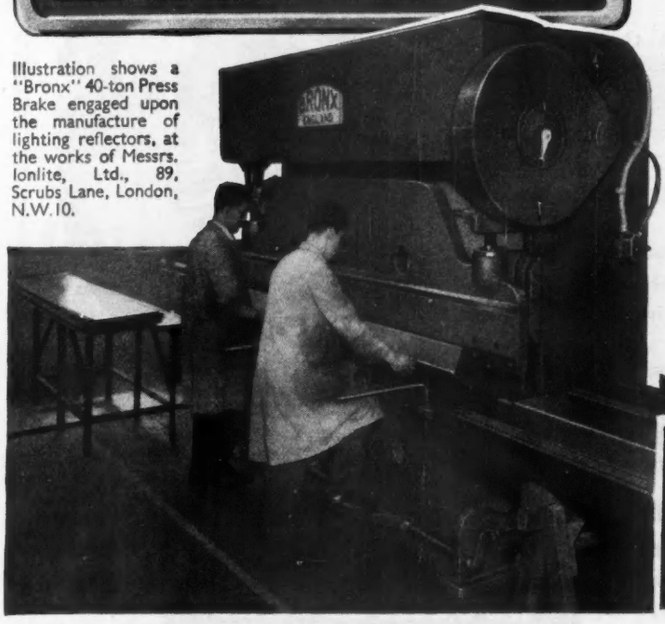

Illustration shows a "Bronx" 40-ton Press Brake engaged upon the manufacture of lighting reflectors, at the works of Messrs. Ionlite, Ltd., 89, Scrubs Lane, London, N.W.10.

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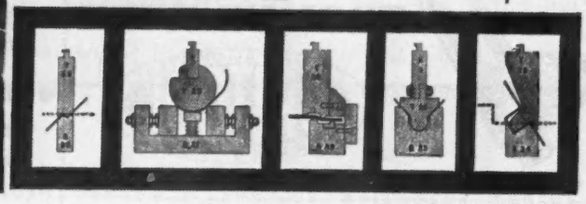

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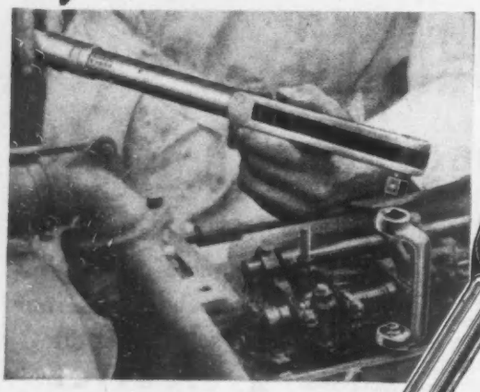

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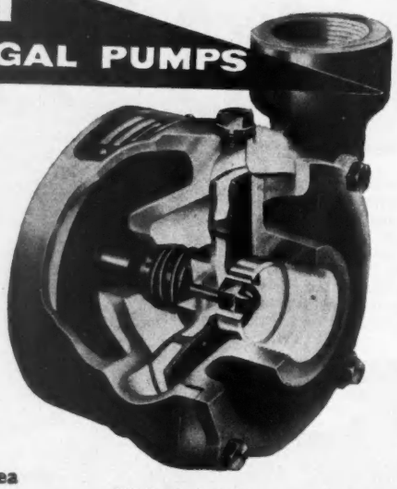
**'Seal' CENTRIFUGAL PUMPS**



These Girdlestone pumps have been designed to ensure efficient mechanical shaft sealing. The simple and effective arrangement of the seal has these advantages.

- **Complete cooling of seal by liquid pumped without flushing pipes.**
- **Large internal liquid area prevents suspended or foreign matter settling around seal.**
- **Simple seal replacement by removal of suction end cover and impeller only.**

Mechanical seals can be fitted for handling a wide range of solvents, acids and other difficult liquids. Pumps available in five sizes from ¾ in. to 1¼ in.—cast iron, bronze or stainless steel. All sizes have same shaft and flange dimensions for interchangeability of mounting —direct couples, belt-driven or as motorpump unit.

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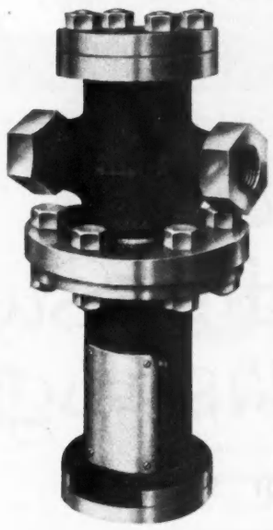
T.115

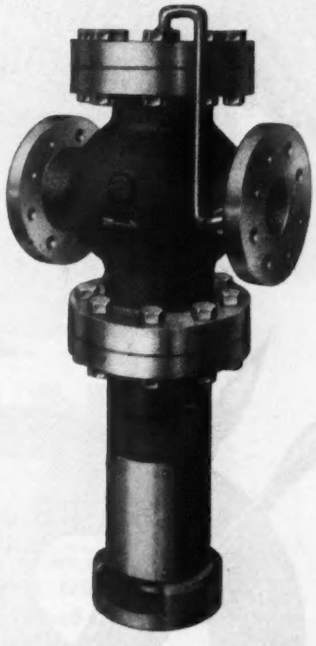
*for industrial applications*

A range of high quality reducing valves, combining simple, robust construction with favourable control characteristics. Available in cast iron, bronze, carbon steel or stainless steel with an extensive choice of trim materials, interchangeable

# PRESSURE REDUCING VALVES

trim types and sizes, and interchangeable control springs, they provide efficiently for a wide variety of applications on liquids, steam or gas service. In the majority of sizes the back pressure regulator form is also available.





**R1**

Body sizes : $\frac{3}{8}$ in., $\frac{1}{2}$ in., $\frac{3}{4}$ in., 1 in., (full or reduced area trim). Connections : screwed, B.S.P. or A.P.I; flanged, B.S.T. or A.S.A. Overall operating range: temperatures up to 600°F; inlet pressures up to 1200 psig; reduction ratios from 1.2 : 1 to 250 : 1. Maximum outlet pressure : 350 psig.

*For full particulars see publication No. 228A.*

**R2**

Body sizes: 1 in., $1\frac{1}{2}$ in., 2 in., $2\frac{1}{2}$ in., 3 in., 4 in., 6 in., 8 in., (full or reduced area trim). Connections: flanged B.S.T. or A.S.A. Overall operating range : temperatures up to 600° F, inlet pressures up to 300 psig., reduction ratios from 1.2 : 1 to 10 : 1, maximum outlet pressure 50 psig.

*For full particulars see publication No. 231.*

**R3**

Body sizes: 1 in., $1\frac{1}{2}$ in., 2 in., $2\frac{1}{2}$ in., 3 in., 4 in., 6 in., 8 in., (full or reduced area trim). Connections: flanged B.S.T. or A.S.A. Overall operating range: temperatures up to 600° F, inlet pressures up to 300 psig, reduction ratios from 1.2 : 1 to 6 : 1, maximum outlet pressure 250 psig.

*For full particulars see publication No. 230.*

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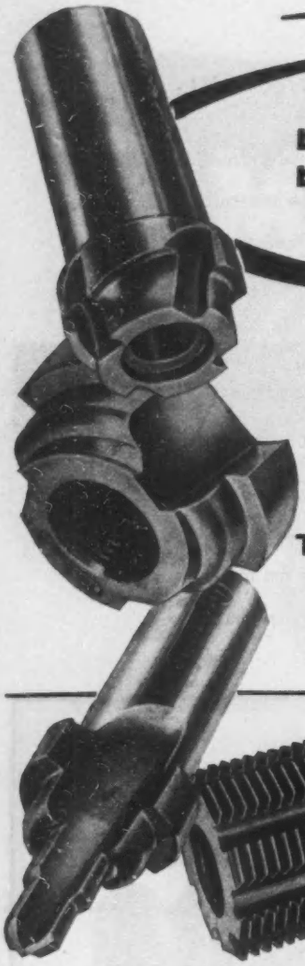

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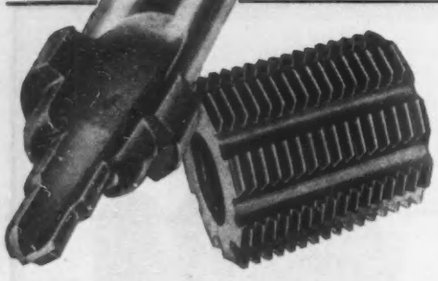

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*a new Chatwin publication.*

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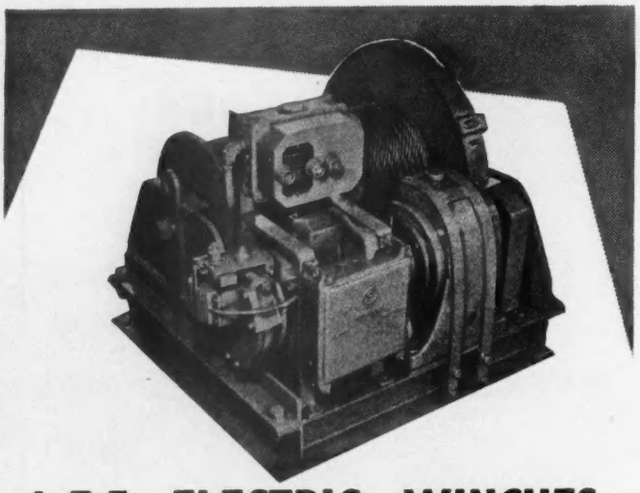

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**portable and self-contained**

After using an electric winch supplied by London Electric Firm Ltd., Metropolitan-Vickers Electrical Co. Ltd., of Manchester found it so satisfactory that they placed an order for three more.

Portable, self-contained and capable of handling loads of up to 2½ tons, these winches are made with the skill and precision which characterises all L.E.F. winches.

Send for details of standard equipment or we shall be glad to manufacture to your special requirements.

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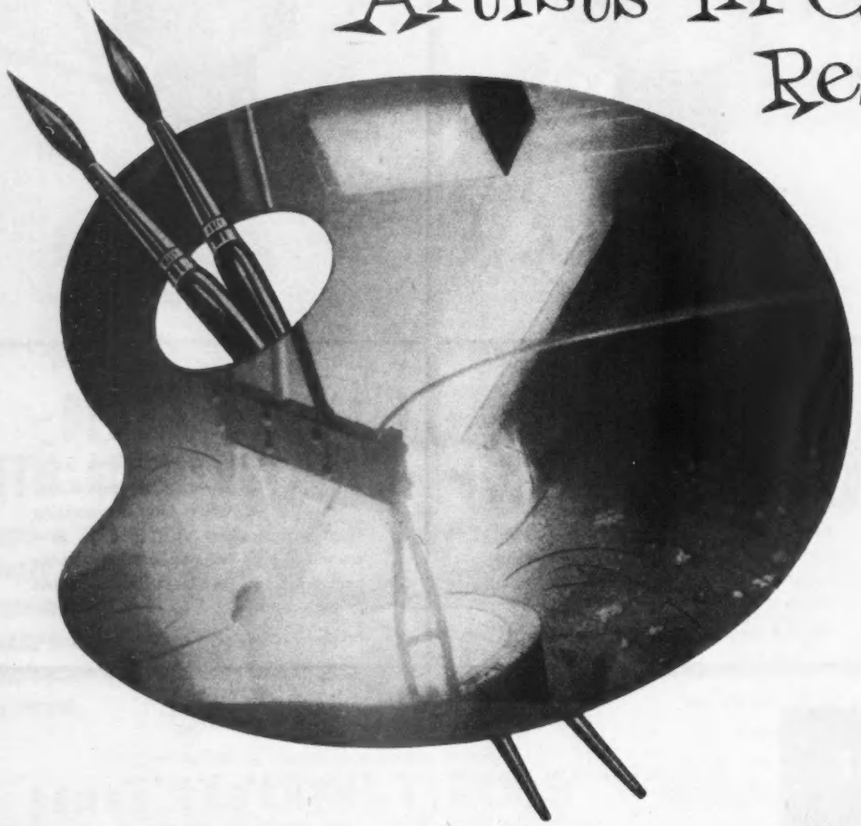

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*All castings can be machined in our modern machine shops*

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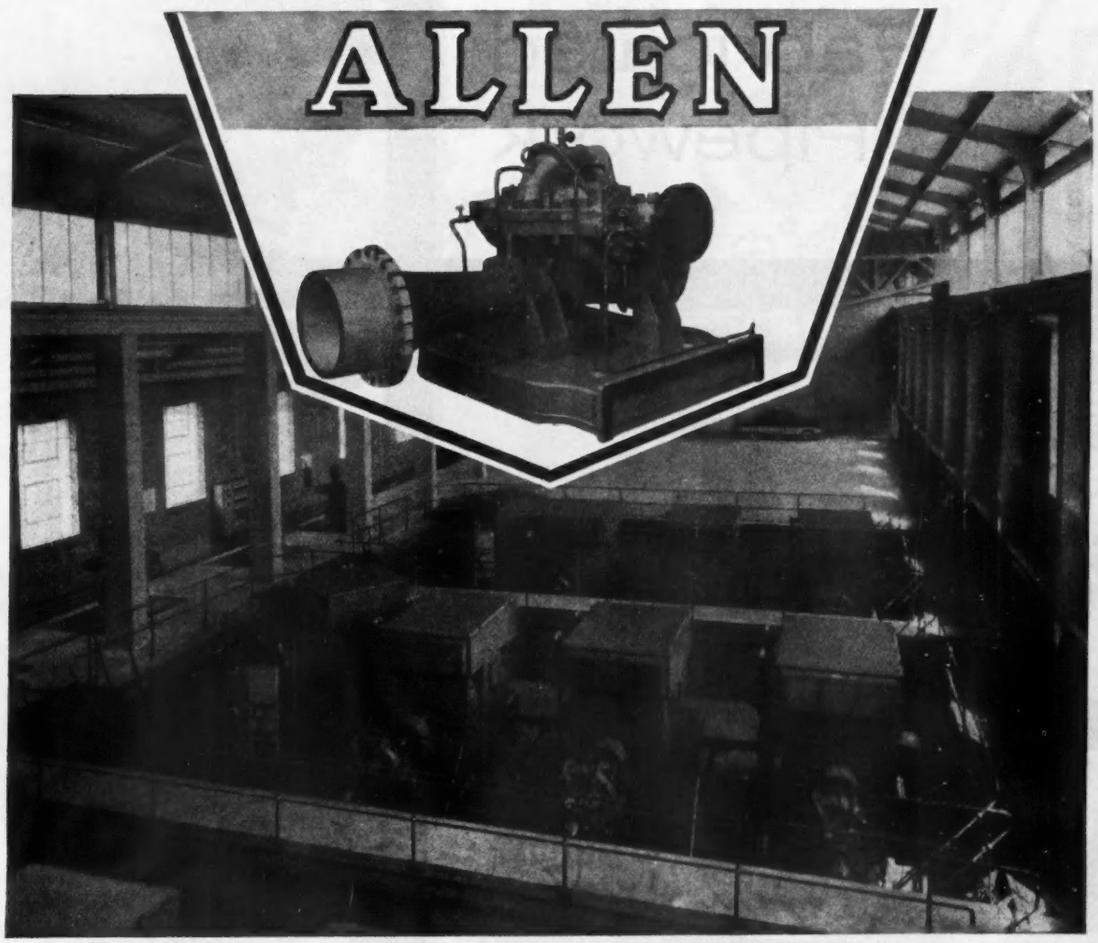


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**This waterworks installation on the Rand, comprises nine 22/22-in. Allen main double-suction pumps driven by 1430-h.p. Metro-Vick motors, and three 22/22-in. Allen booster pumps driven by 390-h.p. Metro-Vick motors. The combined duty of each set of three main pumps and one booster pump is 15,000,000 Imperial gallons per day against a head of 1150 feet.**

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Many Allen pumping plant installations of large size have been completed on the Rand during the past 30 years; the total capacity of steam turbine and motor-driven plant supplied or on order exceeds 90,000 horse-power.

***Specialists in complete Pumping Plant Installations***

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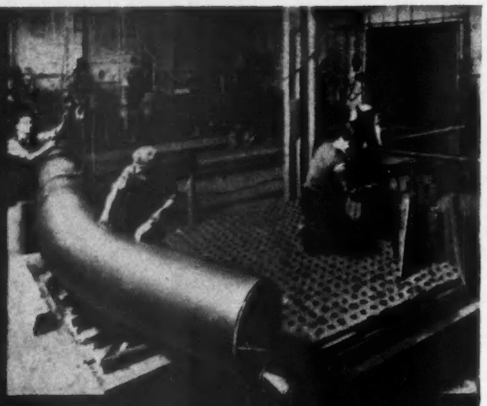
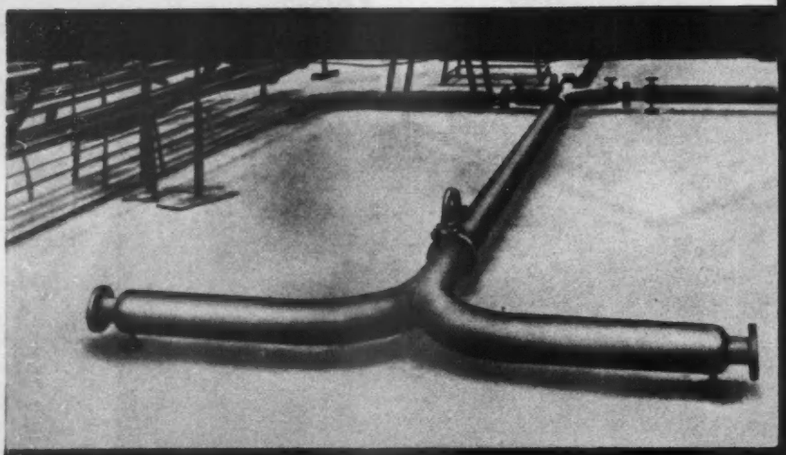
# "Steels" Fabricated Pipework

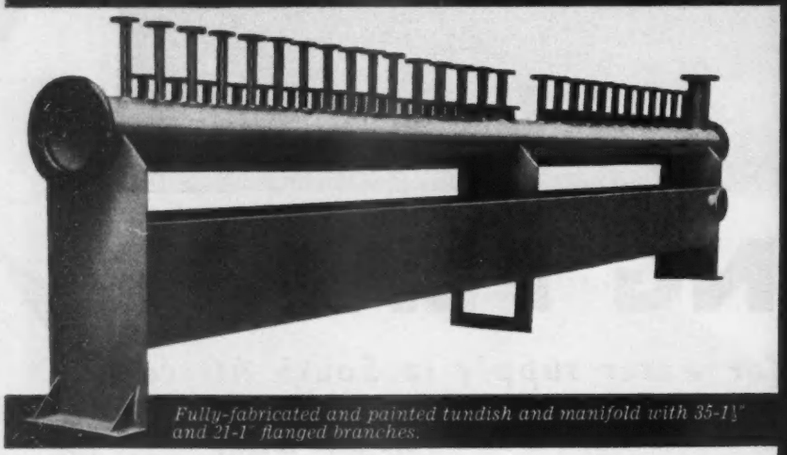


*Fire bending process on a large bore steel pipe.*



*Steam-jacketed Bitumen pipeline for Kuwait Oilfields.*

*Bonn's Bending Machine installed in one of our bays in full operation*



*Fully-fabricated and painted tundish and manifold with 35-1½" and 21-1" flanged branches.*

*Pipework for hot water supply in large retail store.*

"Steels" have an extensive specialised knowledge and experience of all tube fabrication methods. Quality, design and rapid execution of orders, backed by first class metallurgical and testing laboratory facilities, have placed "Steels" fabrication in industry throughout the world.

Fabricated to British and American standards.

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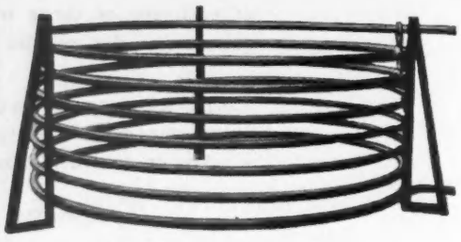

*7 ft. diameter coil of stainless steel tubing with stainless steel brackets and clips.*

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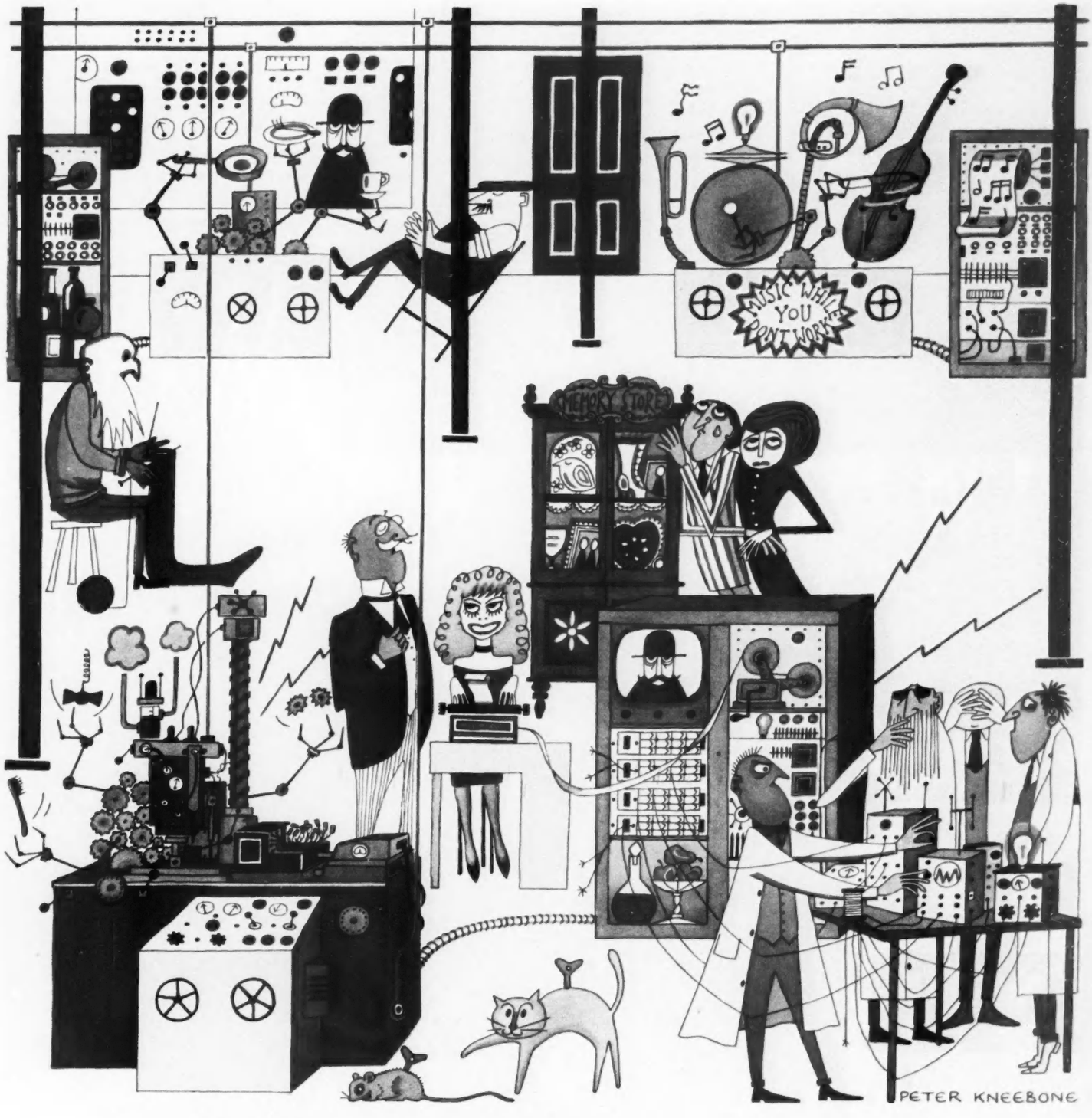


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SHELL

**leadership in lubrication**

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**A Multi Station Indexing Machine producing Differential Pinions of the Massey-Ferguson 35 Tractor at a production time of one set of four per 100 seconds.**

*Photo by courtesy of The Standard Motor Co. Ltd.*


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# FIRTH BROWN

## ...demand the latest techniques in steel making

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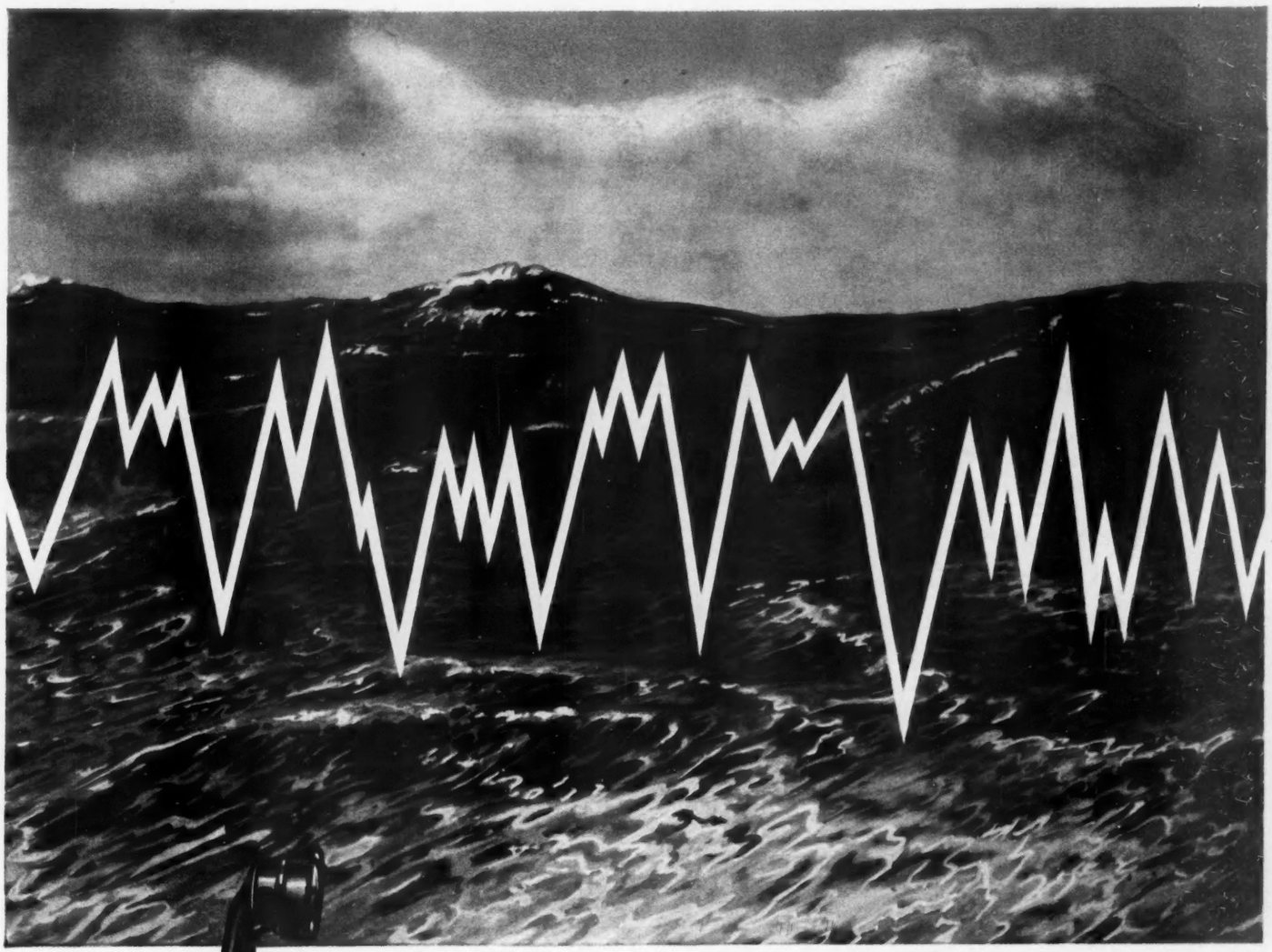

# Telecommunications

Two recent major steps in the improvement of world telecommunications have been the laying of the first Trans-Atlantic and the California—Hawaii submarine telephone cables.

When laying cable either on a flat sea bed or over underwater mountain ranges, the exact control of paying out speed and tension in the cable is of paramount importance. On the cableship *Ocean Layer* (Submarine Cables Ltd.), the cable-laying equipment for which was supplied by Johnson & Phillips Ltd., 'VSG' variable delivery oil hydraulic pumps are used to act as brakes on the cable, which is drawn out of the ship by its own weight. This enables a very smooth and regulated control to be maintained or instantly varied to suit ship speed, paying out speed and tension in the cable.

It is just another of the highly varied applications of 'VSG' variable delivery pumps and transmission gears which have now been serving modern industry for fifty years.

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**JOHN BULL** *Rubber*

***Solves your problems***

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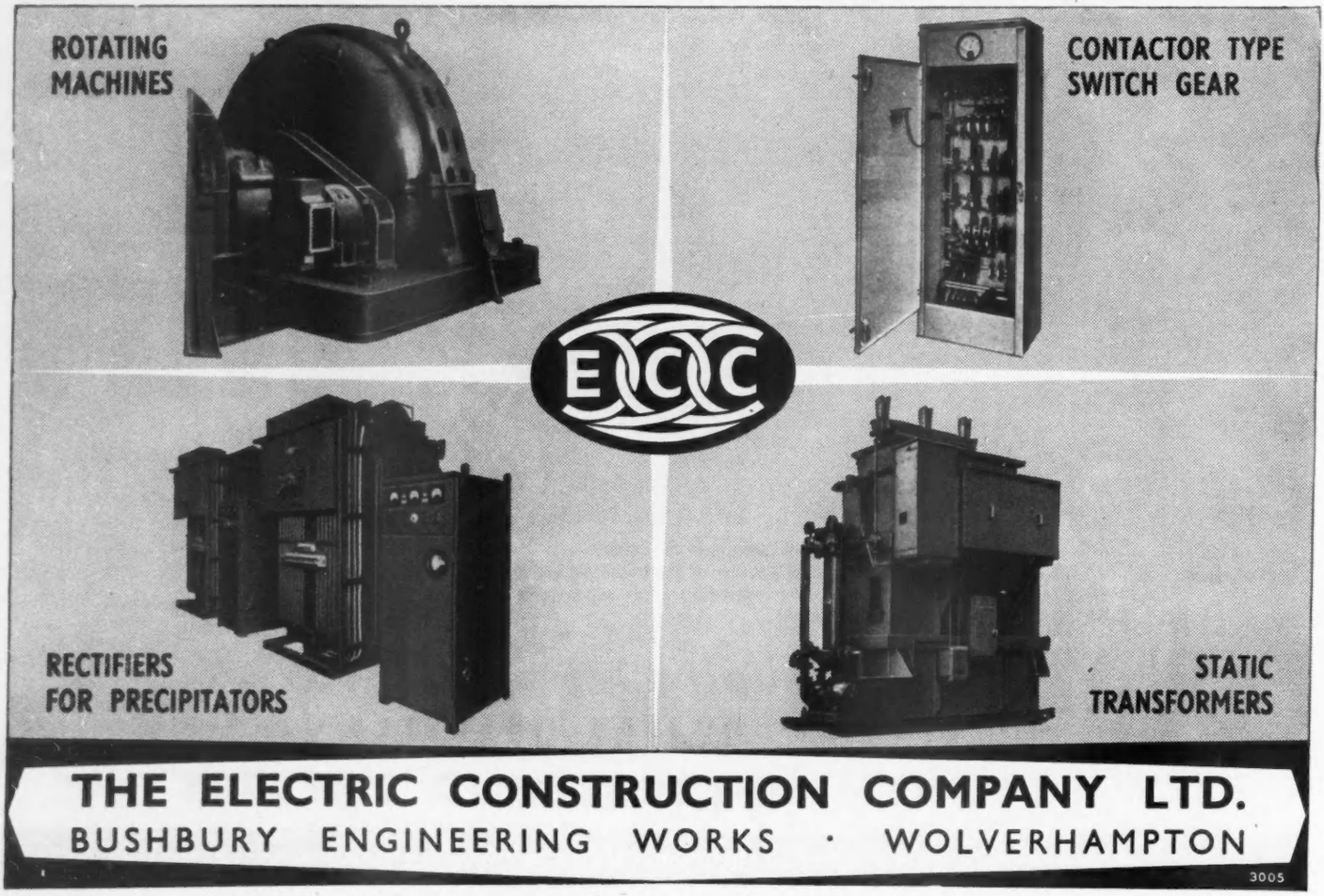


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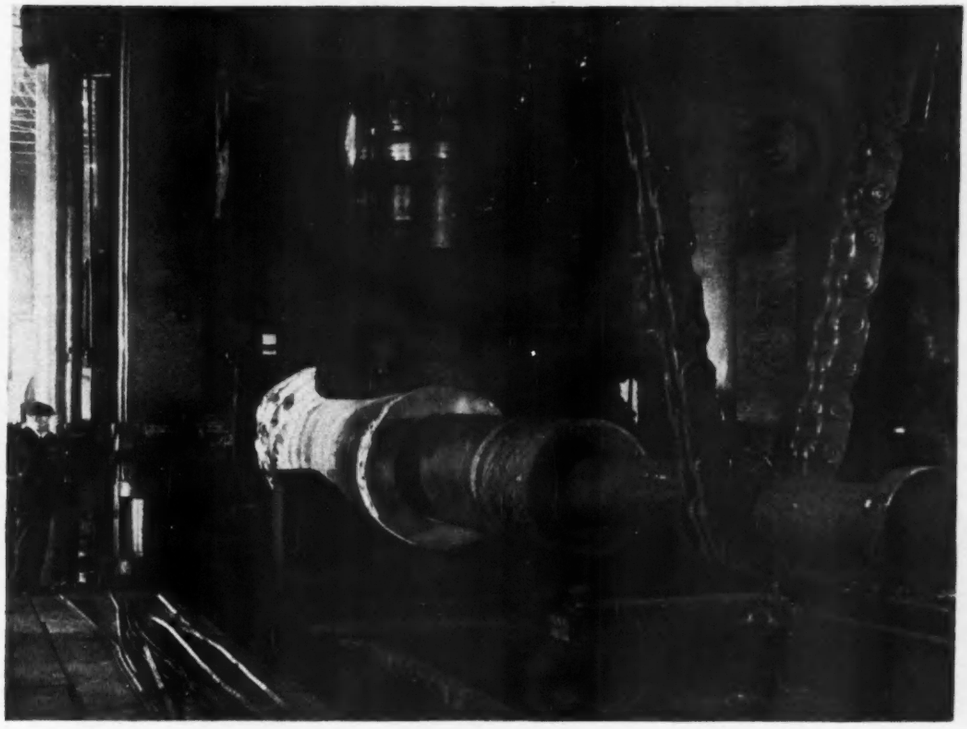
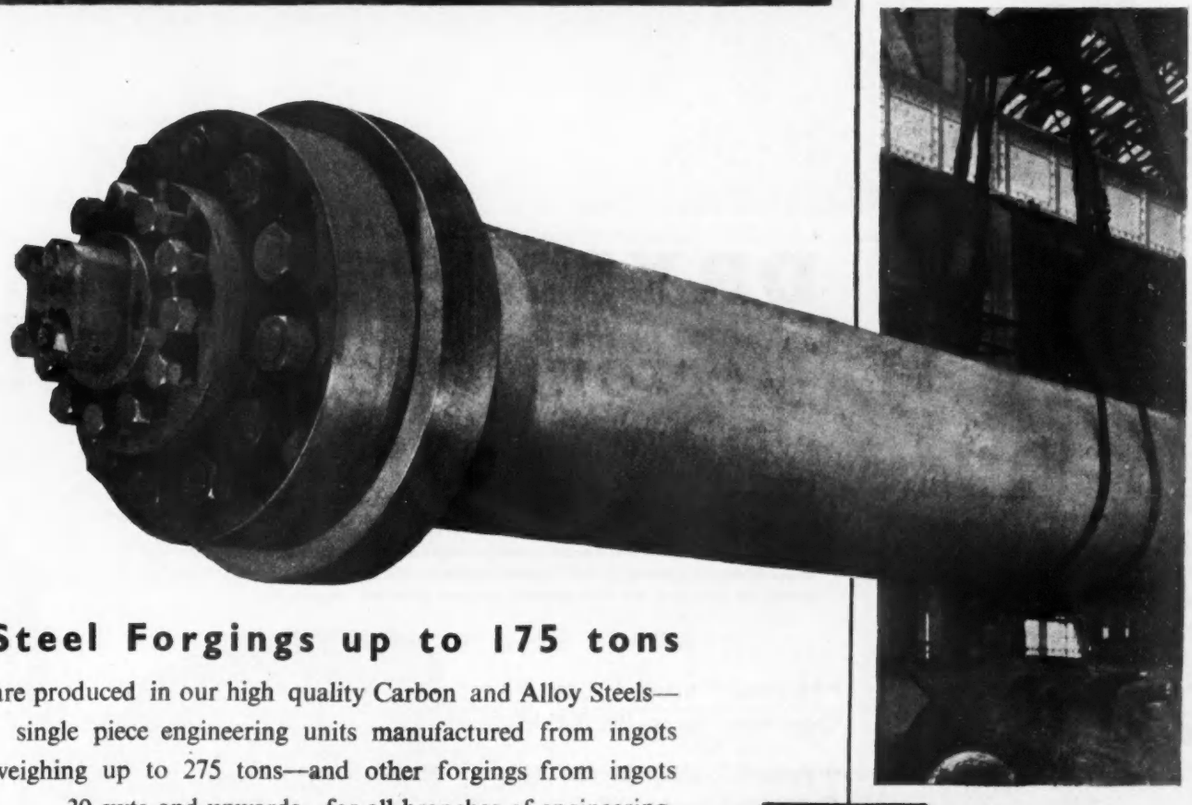


**The manufacture of hollow forged high pressure vessels for petroleum and chemical engineering has been for many years a speciality of ESC who are the leading makers of this type of forging.**



## Steel Forgings up to 175 tons

are produced in our high quality Carbon and Alloy Steels—single piece engineering units manufactured from ingots weighing up to 275 tons—and other forgings from ingots 30 cwts and upwards—for all branches of engineering.

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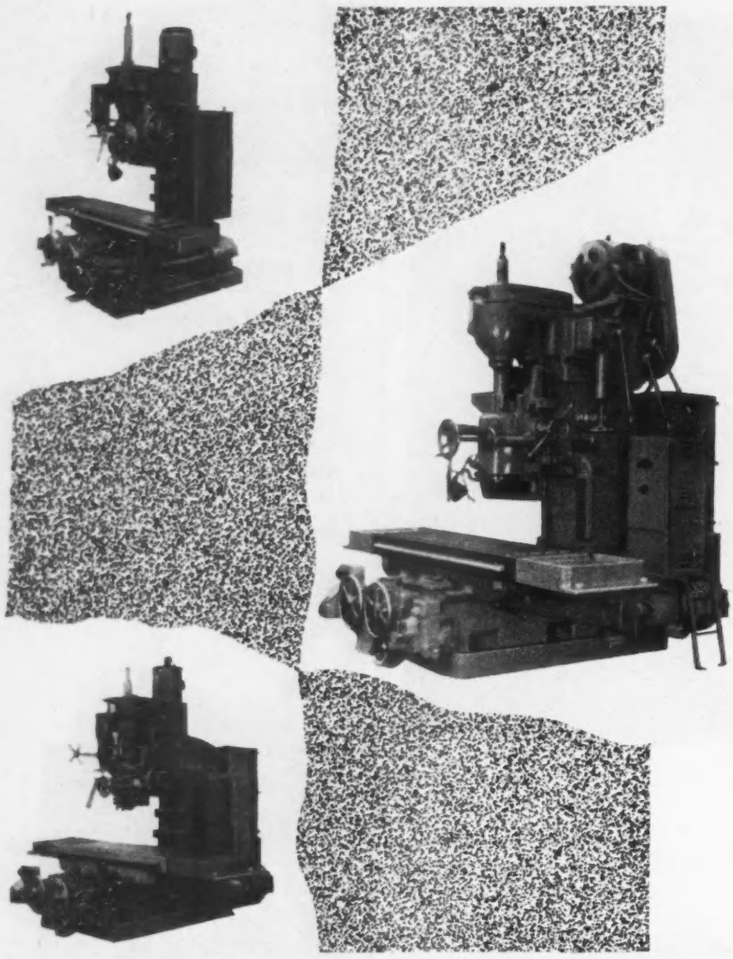
## ENGLISH STEEL FORGE AND ENGINEERING CORPORATION LTD.

**River Don Works, Sheffield**

A WHOLLY OWNED SUBSIDIARY OF ENGLISH STEEL CORPORATION LTD.



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**No. 28A.** For heaviest class of work. 32 speeds, 12 to 540 r.p.m. Electronic feed drive, infinitely variable feeds between 0·8in. and 40in. per min. Quick-power traverse to longitudinal and transverse motions. 62in. by 29in. by 30½in.

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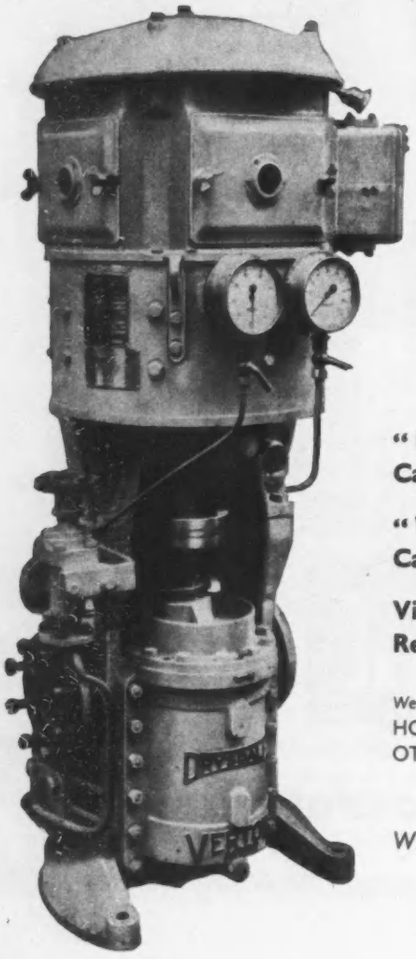

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(PATENT PUMPS)

**These pumps are of the positive displacement rotary gear-wheel type. The "Vertoil" is a marine pump, designed for such duties as forced lubrication, oil fuel service, oil fuel supply, diesel and boiler oil transfer, etc.**

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**"Horzoil" sizes 1½" to 8"**
**Capacities up to 195 T.P.H.**

**"Vertoil" sizes 2½" to 11"**
**Capacities up to 298 T.P.H.**

**Viscosities up to 10,000 sec. Redwood No. 1.**

*We also make pumps for:*
HOT OIL, PETROL AND
OTHER REFINING DUTIES

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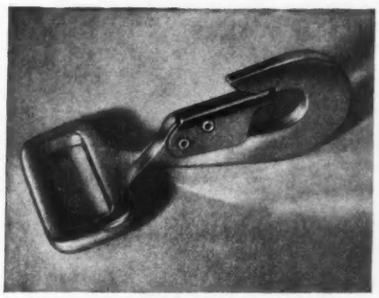
**DRYSDALE & CO. LTD., YOKER, GLASGOW**

# How to select the right alloy

## . . . FOR HIGH STRENGTH

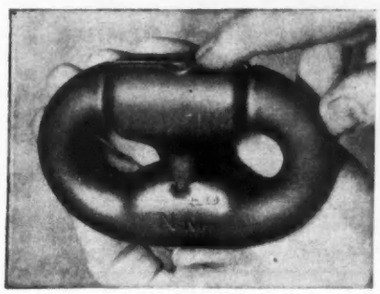


'K' MONEL *snap hook for pilots and observers parachute sets.*

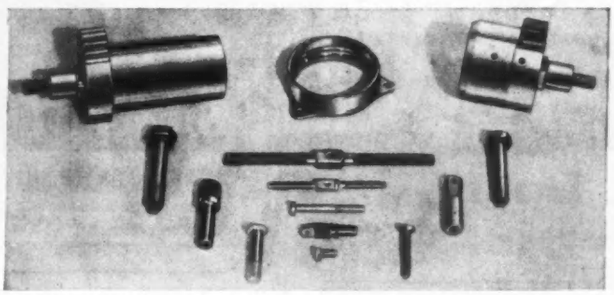
When mechanical strength combined with corrosion-resistance are required, the most suitable material is often one of the wrought high-nickel alloys. Many of these can be heat-treated to give mechanical properties comparable with those of many alloy steels.

'K' MONEL for instance, can be heat-treated to give a tensile strength of 75 tons/sq. in. and a DPN hardness as high as 340. The outstanding strength and hardness of 'K' MONEL have led to its wide acceptance for parts such as pump shafts which often operate under severe mechanical stress in corrosive conditions.

The fact that 'K' MONEL is non-magnetic has led to its use for high strength bolts, rivets, etc., in airframe assemblies where although the strength of alloy steel is required, it is also essential to avoid interference with delicate instruments.



*A non-magnetic Anchor Chain link made of* 'K' MONEL.

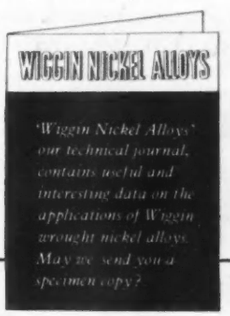


*A selection of* 'K' MONEL *bolts and rivets used in various parts of aircraft.*

**WIGGIN** *KNOW* **NICKEL ALLOYS**

*'K' MONEL is a registered trade mark.*

Resist high and low temperatures | Resist corrosion | Protect product purity | Provide electrical properties | Resist wear | Transfer heat | Provide workability | Provide spring properties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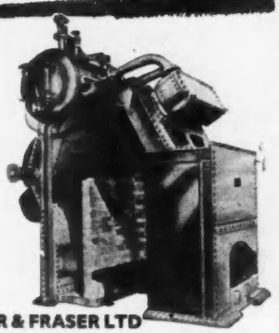
**FRASER WATER-TUBE BOILER**

**81·59% EFFICIENCY**



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- High efficiency
- Economical fuel consumption
- Unusually compact in design
- Adaptable for conventional or waste fuels
- Easy access for maintenance

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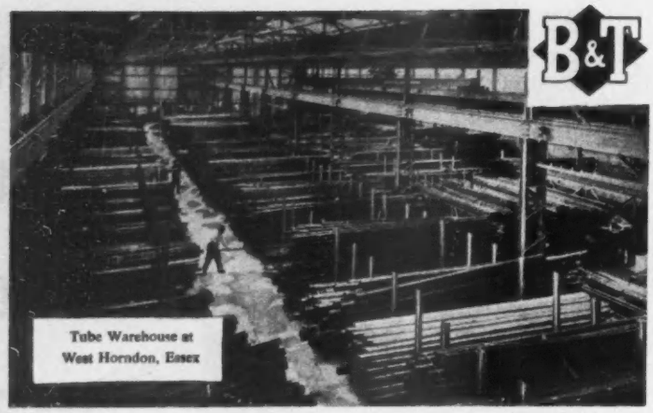
*Industry is year by year proving the value of these claims in Flues, Ash-Pits, Reactors, Cyclones, Cat Crackers, Coke Hoppers, Down Comer Pipes, Hydroformers, Water Turbine Flumes, Underground Galleries etc.*

*Write or telephone for fullest details.*

**CAUSEWAY REINFORCEMENT LIMITED,**

**66 Victoria Street, London S.W.1**

**VICTORIA 8648**



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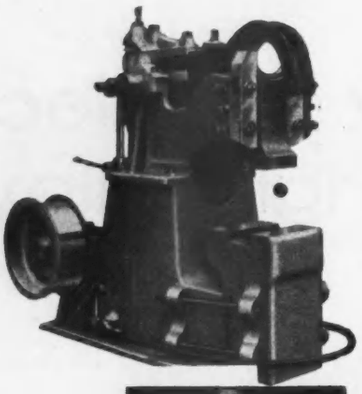

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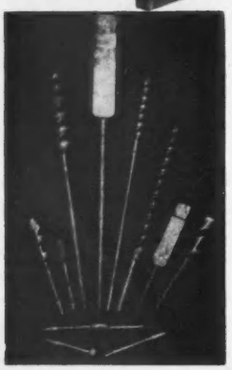

A typical example of the type of work accomplished on this machine.

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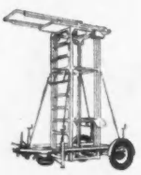

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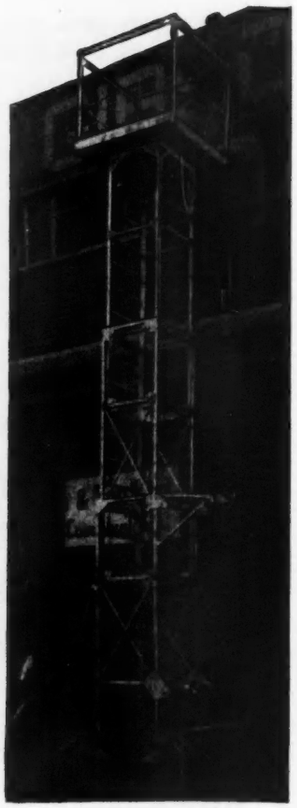

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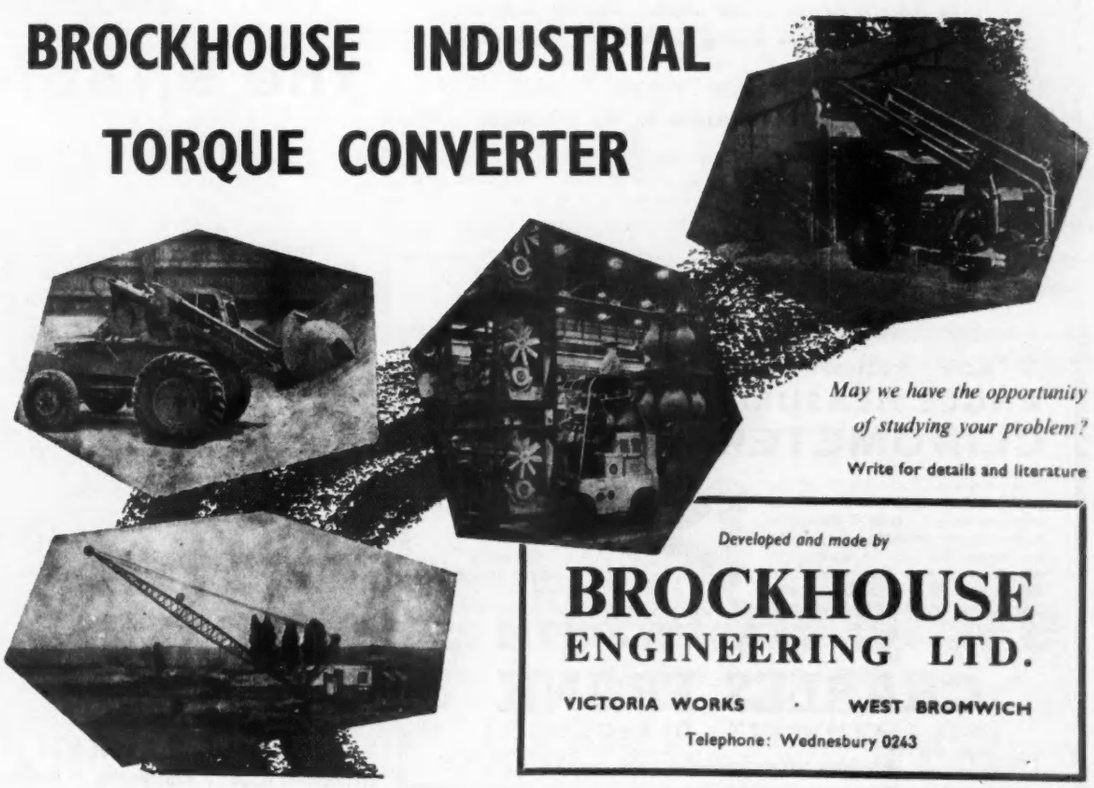

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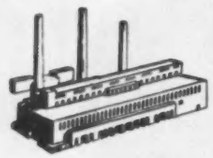

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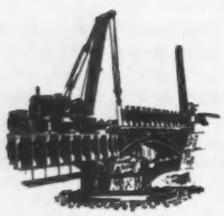

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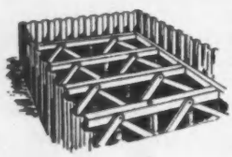

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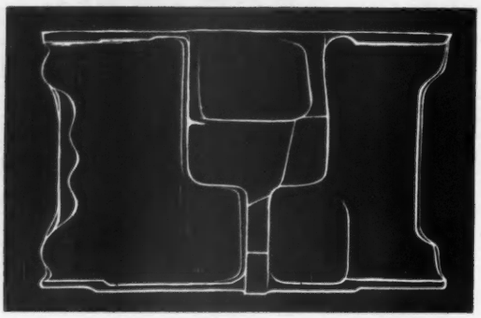

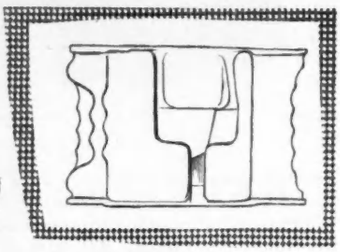

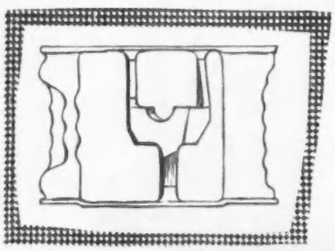

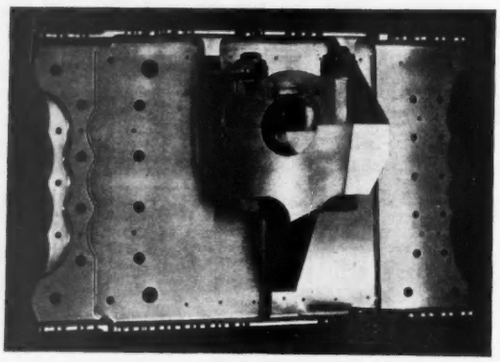

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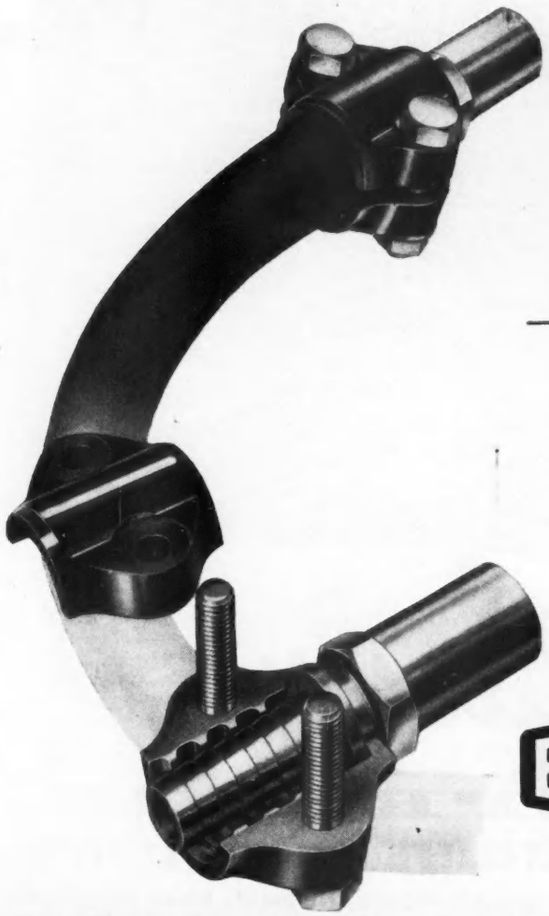

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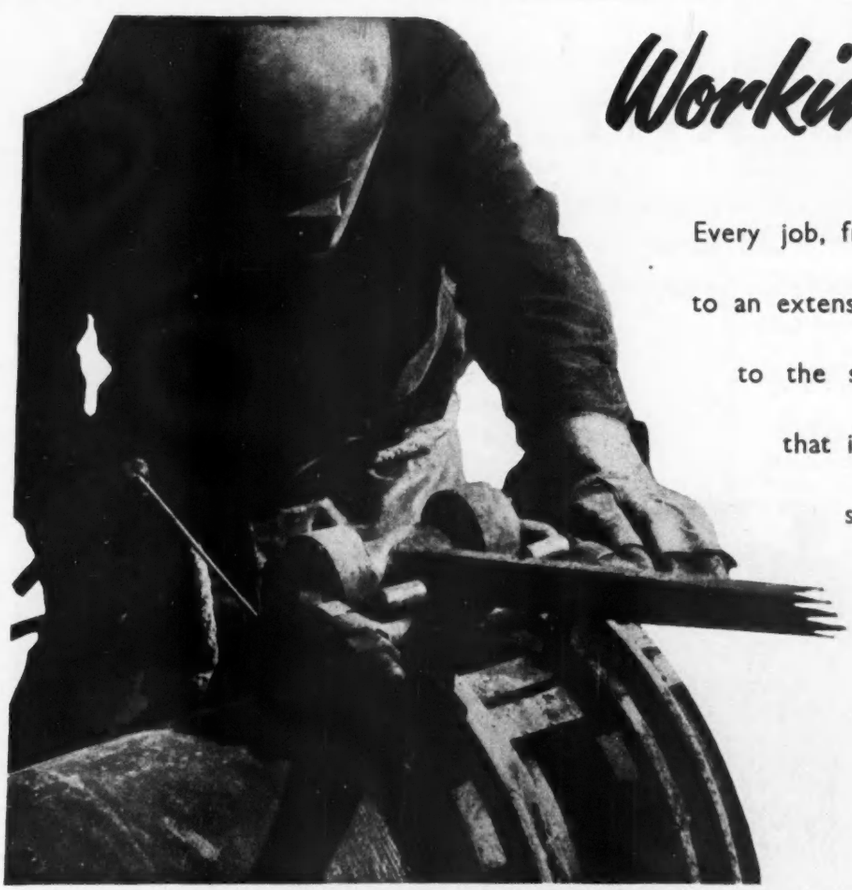

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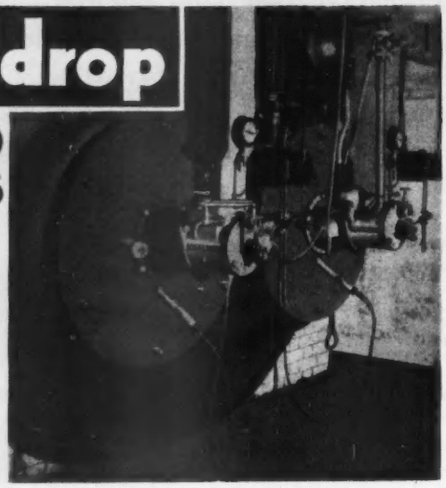

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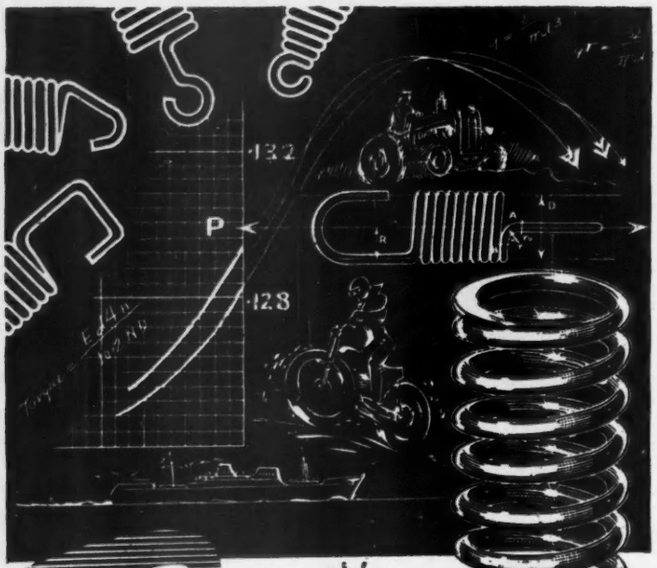


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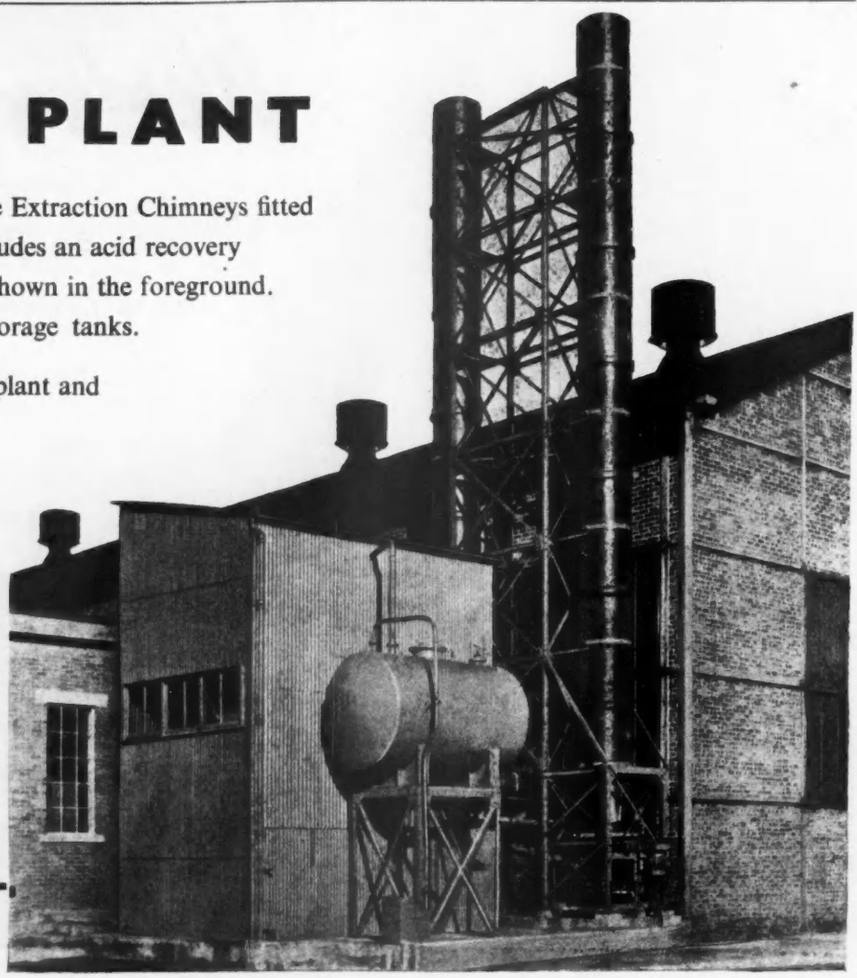

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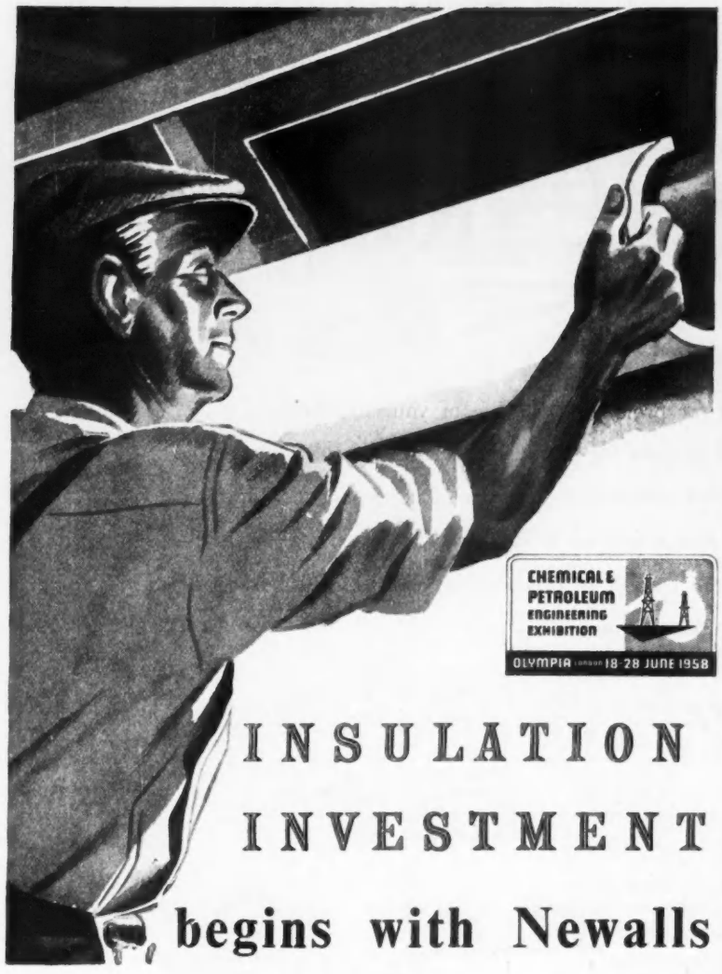


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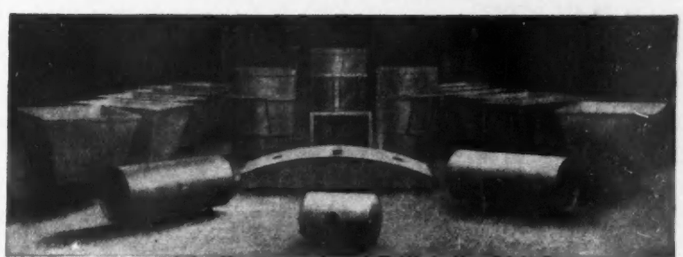

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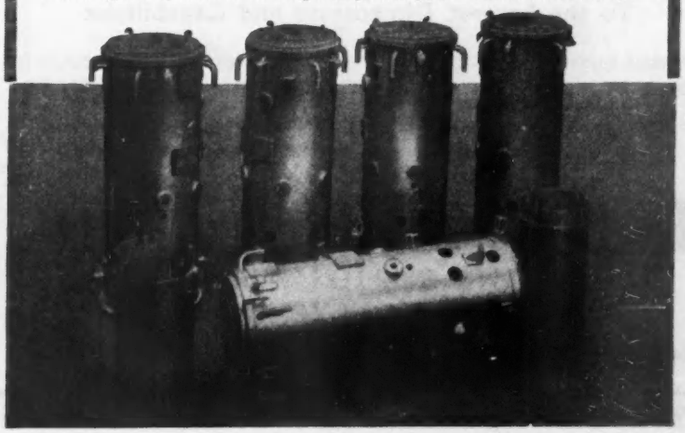

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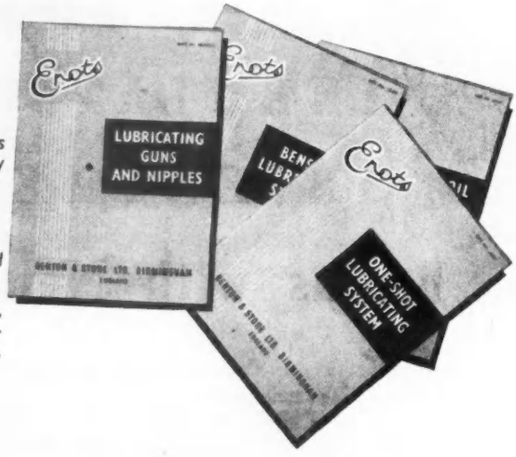


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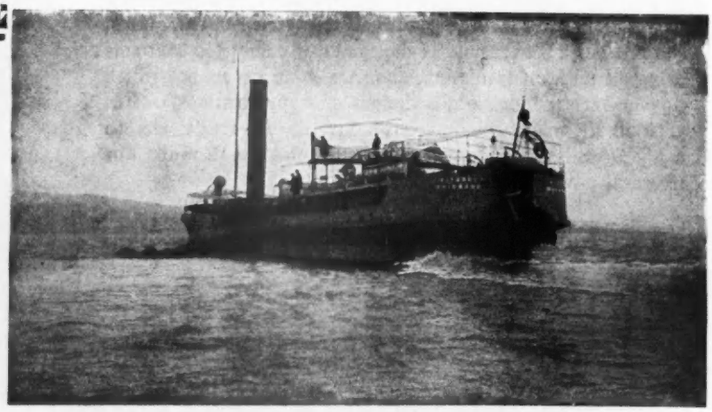

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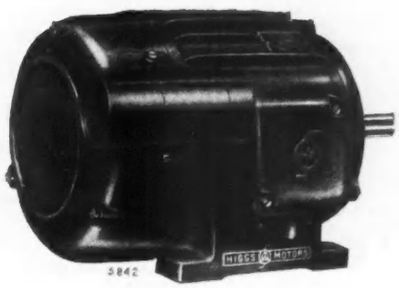


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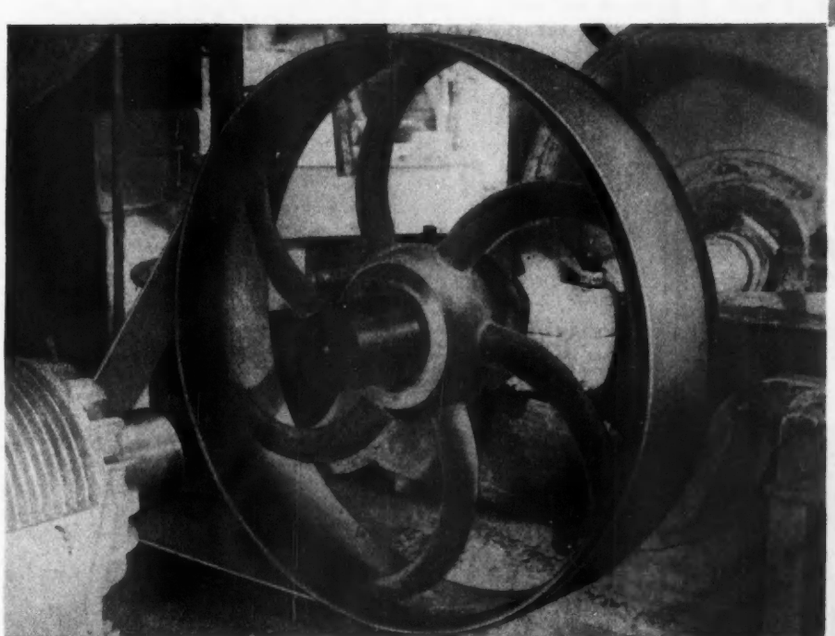
STEPHENS Miraclo



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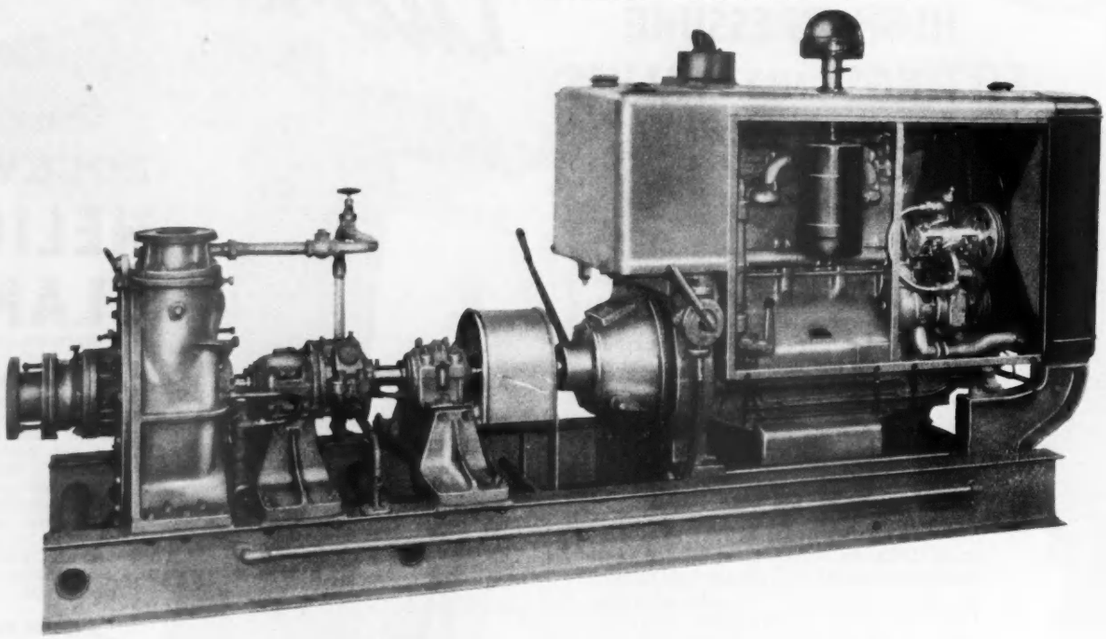
S. 72

# GRAVEL PUMPS



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M.W.56

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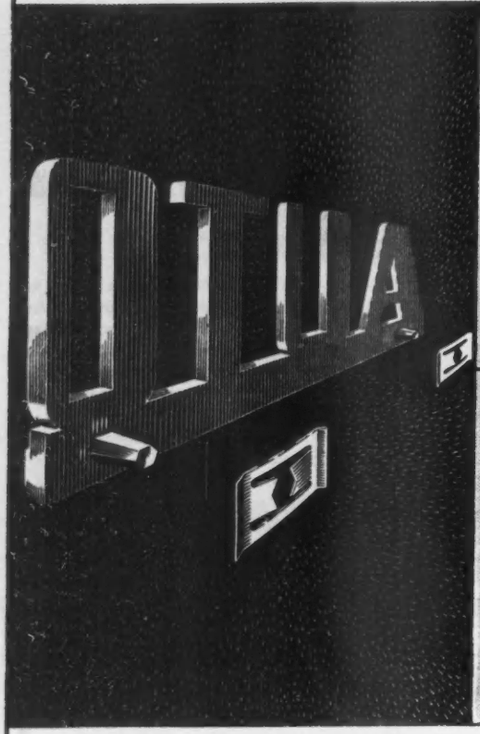
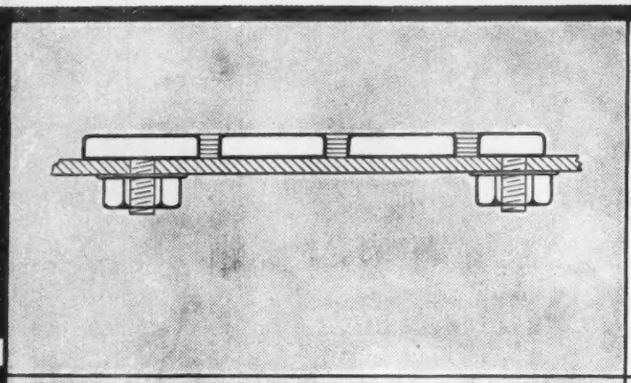
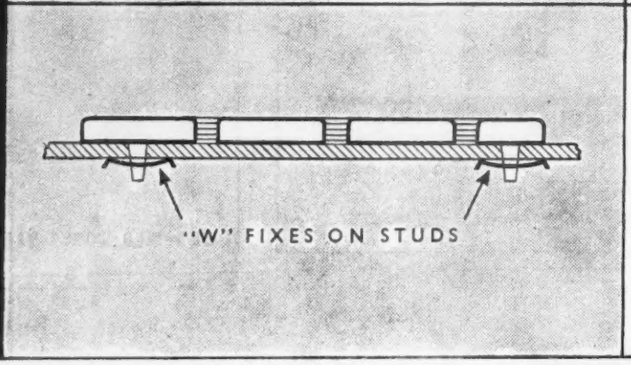




**OLD WAY**

Threaded studs were spot welded (or inserted if die-cast) to the nameplate. To hold this in position, washers and nuts were laboriously assembled with great difficulty especially on blind applications.

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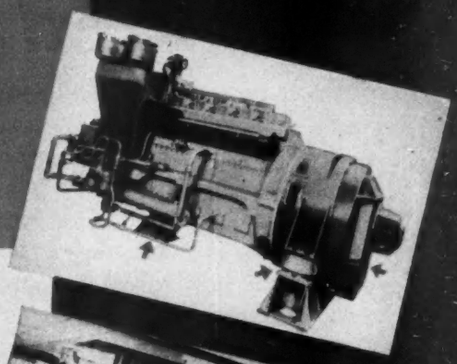
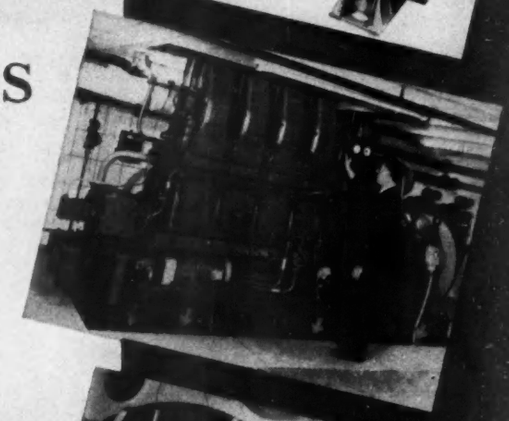
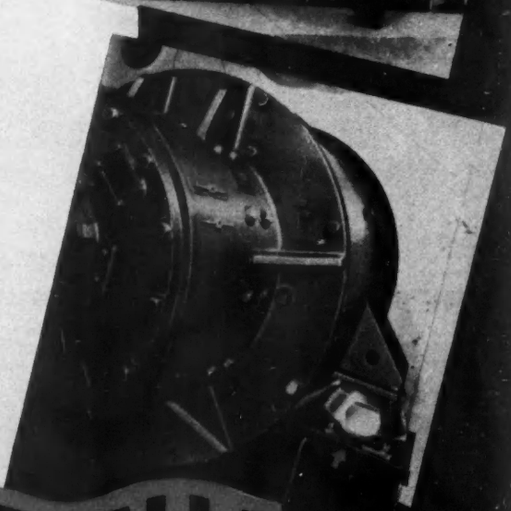
# Cushymounts







## LARGE DEFLECTIONS
### *for Wide Range of Loads*

Cushymounts, based on wide and intensive experience of vibration insulation, provide the large deflections essential for the successful isolation of low-frequency vibration from heavy machinery. A single Cushymount supports as much as five tons and can be adjusted to give any required deflection up to ¾" for loads of one to five tons.

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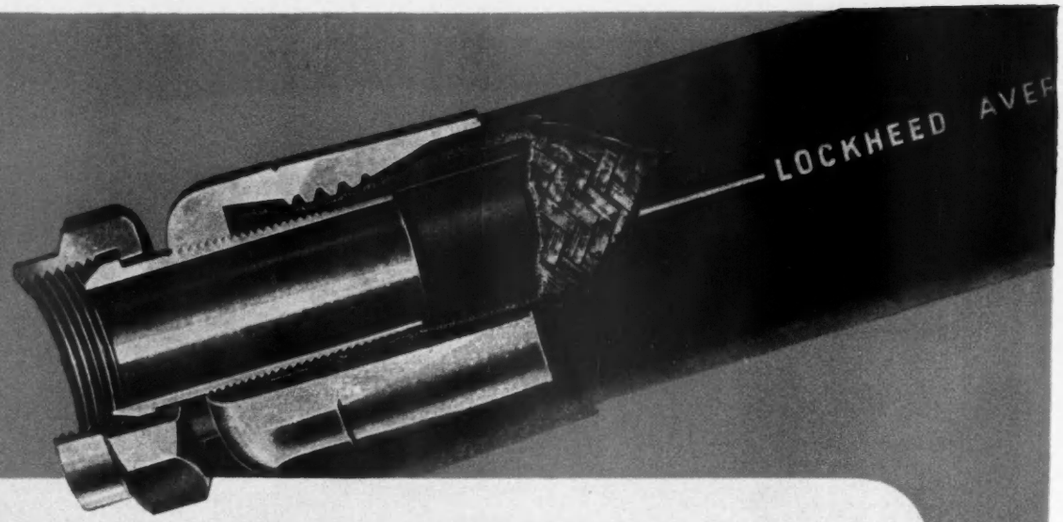
Cushymounts give the designer a complete mounting system. Despite their unusually high deflections no separate buffers or control links are needed, as movement in vertical and horizontal planes is limited to a predetermined amount by positive means incorporated in the mountings. Cushymounts are, therefore, ideally suited to diesel locomotive engines and large generators for use on ships.

The illustrations on the right are: top, a Crossley generating set on three Cushymounts at the Dounreay Atomic Energy Establishment. Centre: 'English Electric' 4-cylinder diesel alternator on six Cushymounts and below: one of the three Cushymounts supporting the power unit on the Metropolitan-Vickers Bo-Bo locomotives for Eire.

# METALASTIK




# New HIGH PRESSURE HOSES

Following the success of their hoses, Lockheed-Avery announce a new range, available with single and double wire braid, with a number of important features.

These hoses are backed by more than 20 years of experience in a wide range of industrial and aircraft hose applications, often in conjunction with other equipment made by the AP group.

The hoses are suitable for pressures ranging from 300-lbs. per sq. in. for 2" bore hose to 4050-lbs. per sq. in. for $\frac{1}{8}$" bore hose.

End-fittings are of steel, with hexagonal sleeves which expedite fitting, and are re-usable.

When desired, swaged-on end-fittings can be supplied for hoses up to $\frac{3}{8}$" bore.

90° elbows and 45° bends are available.

## FOUR DIFFERENT LININGS

These new hoses types 77-99 have the advantage that they can be supplied with any one of these four linings:

*NITRILE : NATURAL RUBBER : BUTYL : NEOPRENE*

A list of compounds, with the lining recommended, can be supplied on request. The longest length of hose obtainable remains at approximately 30 ft. for hoses of $\frac{3}{8}$" bore and over, and approximately 15 ft. for hoses of $\frac{1}{4}$" and $\frac{1}{4}$" bore. Within these limits any desired length of hose assembly can be supplied.

### FEATURES

*Re-usable steel end fittings for strength and convenience*

*Hexagon sleeves for ease of assembly*

*Cadmium plated for corrosion resistance*

*Choice of four linings*

*Elbows and bends available*

*Wire braiding gives great safety.*

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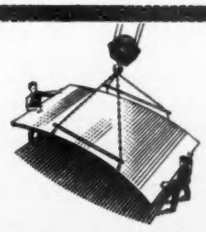

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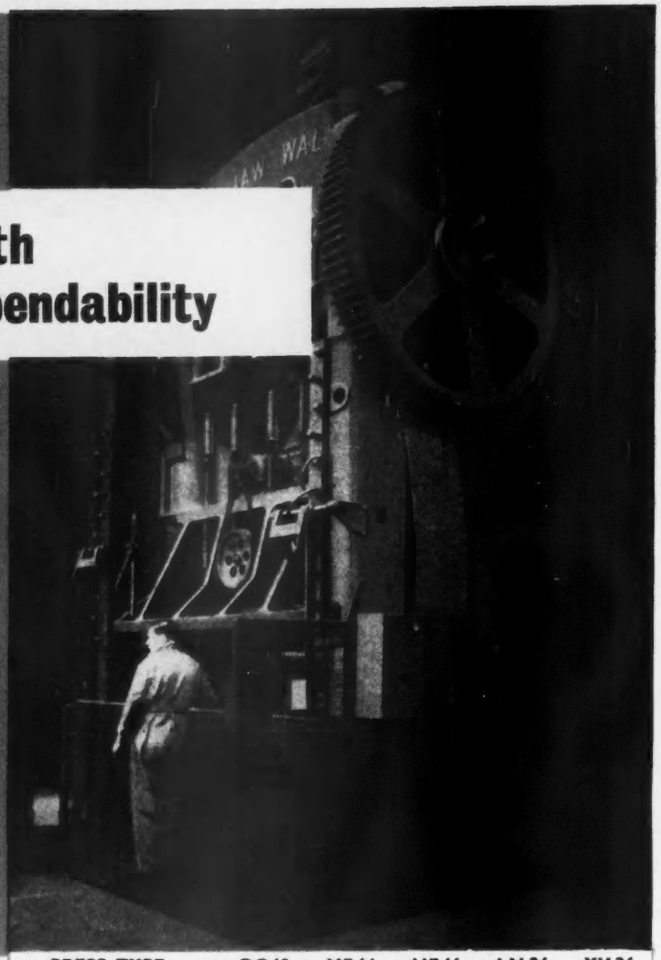

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|---|---|---|---|---|---|
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| BETWEEN SIDES ins. | 75½ | 63 | 109½ | 109½ | 130½ |
| STROKE ins. | 10 | 14 | 16 | 24 | 34 |
| SLIDE F to B x R to L ins. | 30 x 68½ | 42 x 54 | 54 x 99½ | 63 x 99 | 70 x 120 |
| BED F to B x R to L ins. | 36 x 72 | 60 x 61 | 60 x 108 | 76 x 108 | 70 x 129 |
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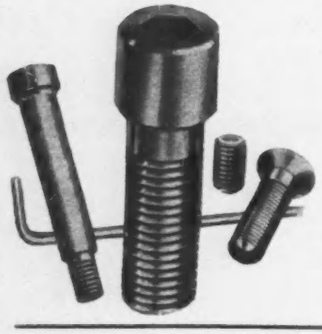

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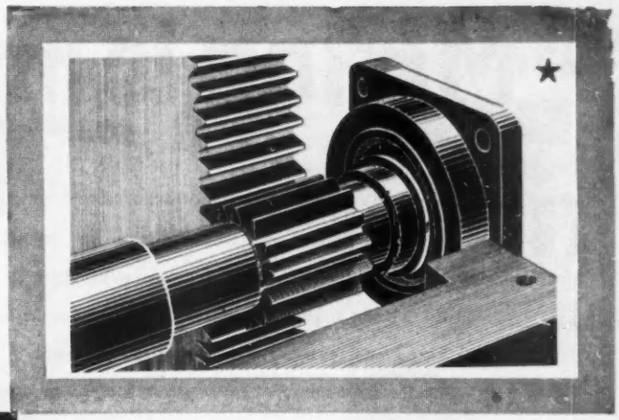

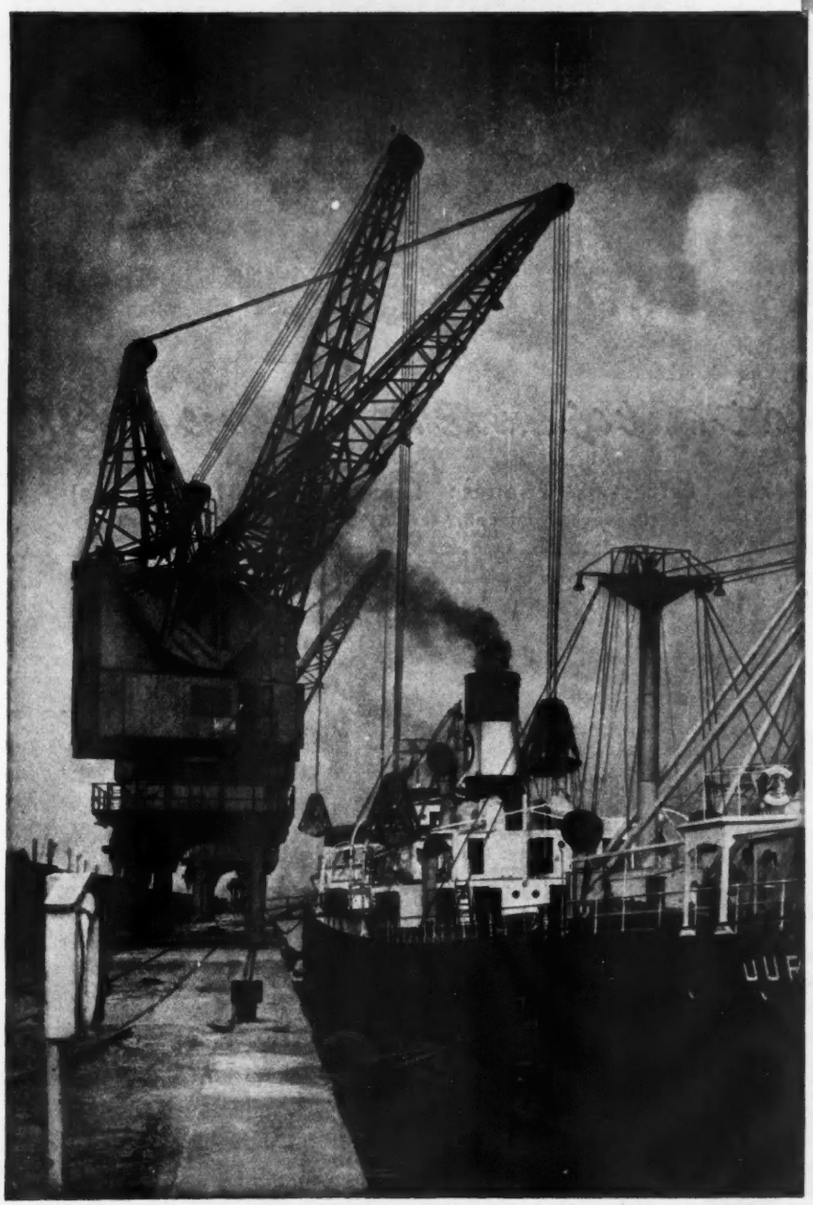

*Clyde 7½ ton Level Luffing Cranes at work on the Manchester Ship Canal.*

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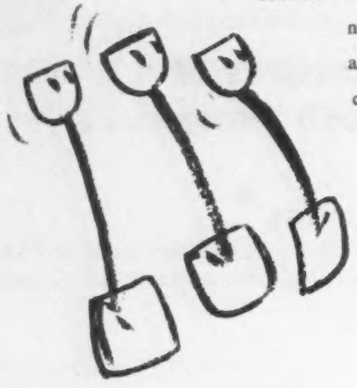

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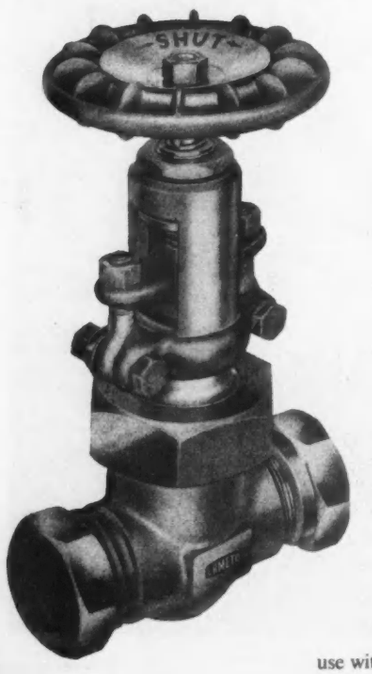


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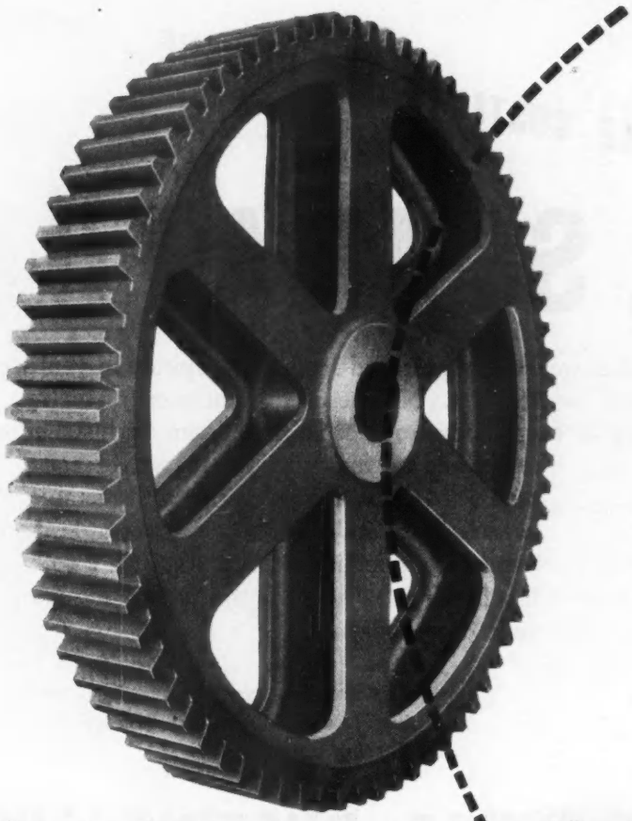

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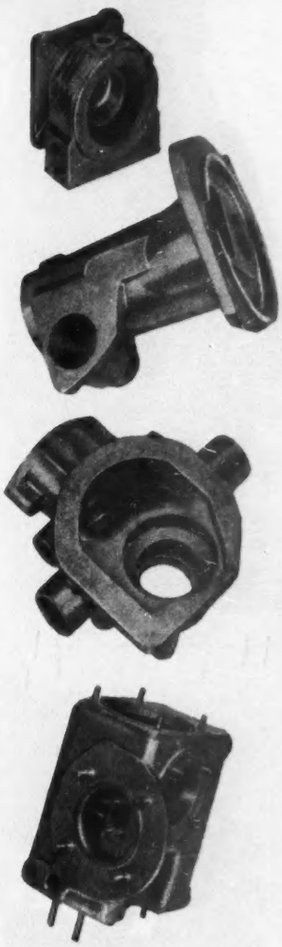

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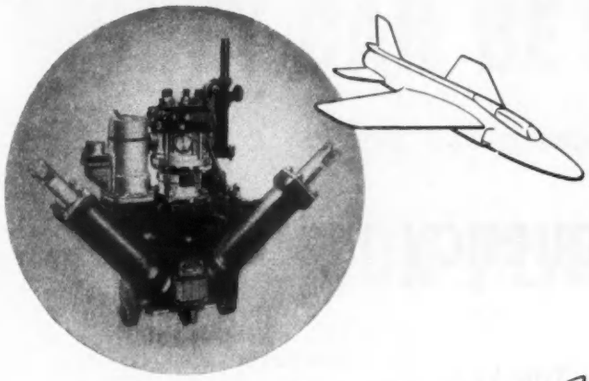

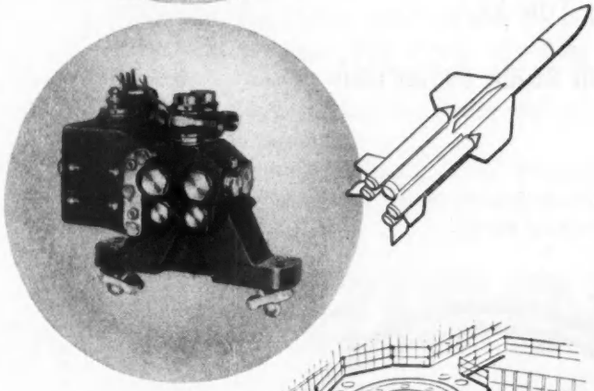

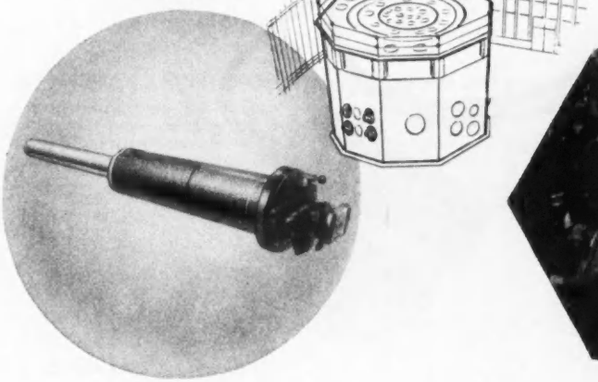

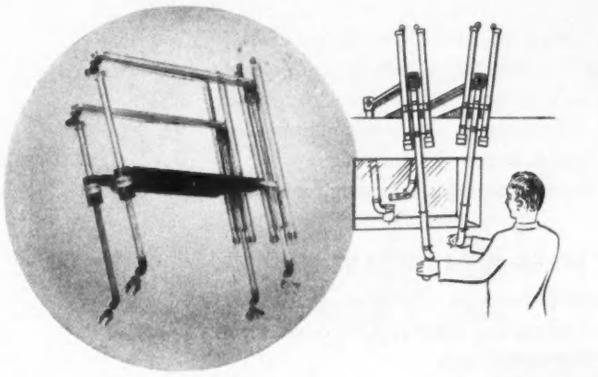

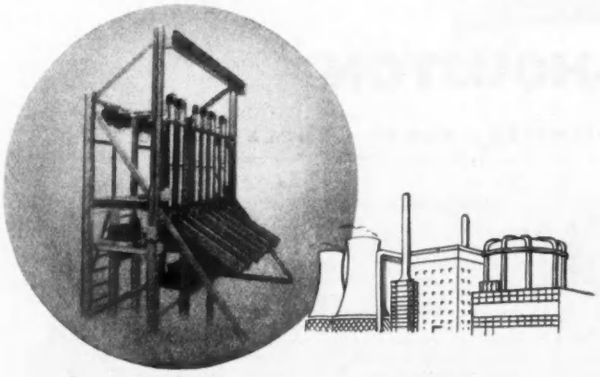

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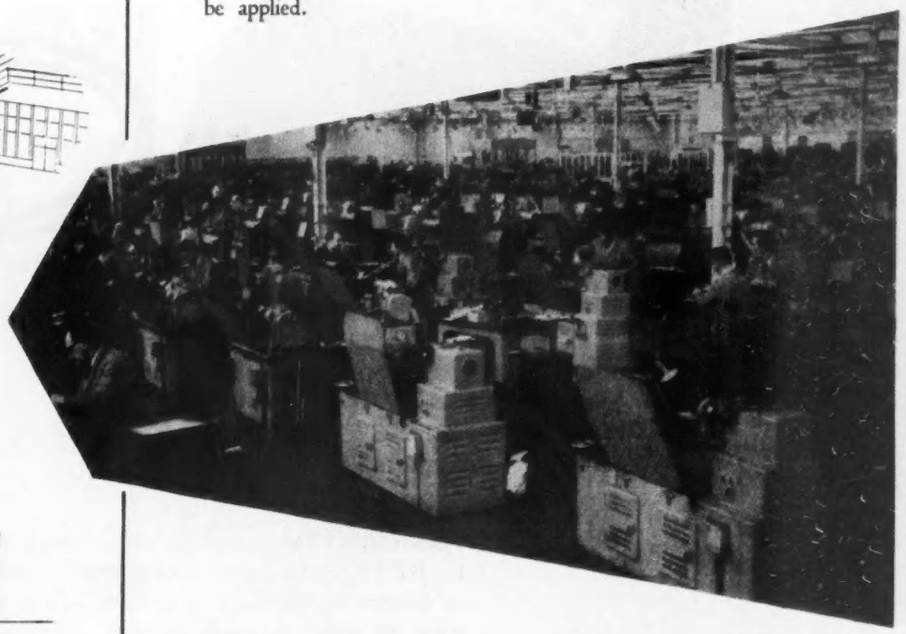

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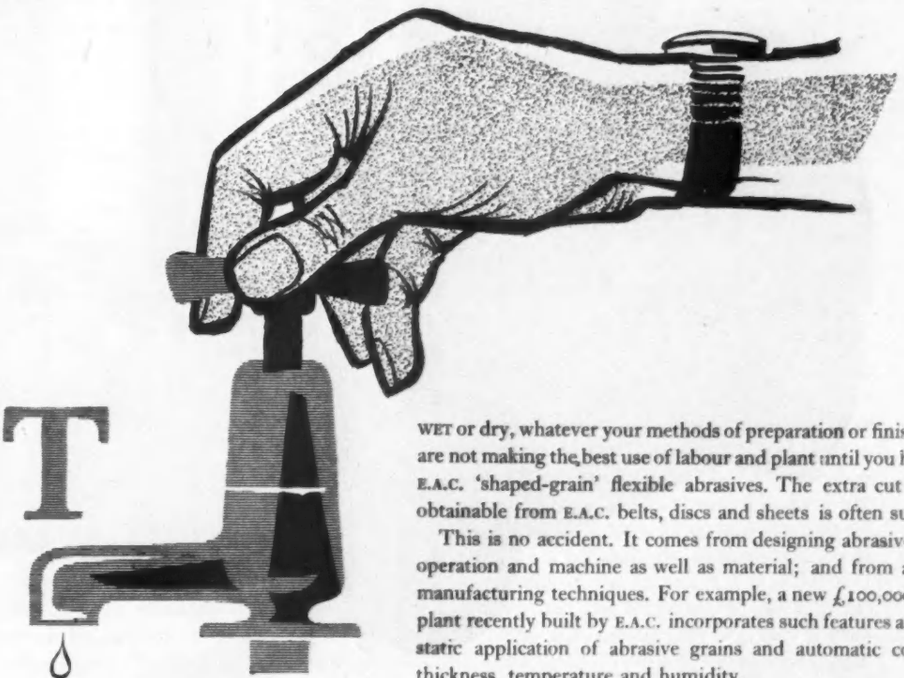

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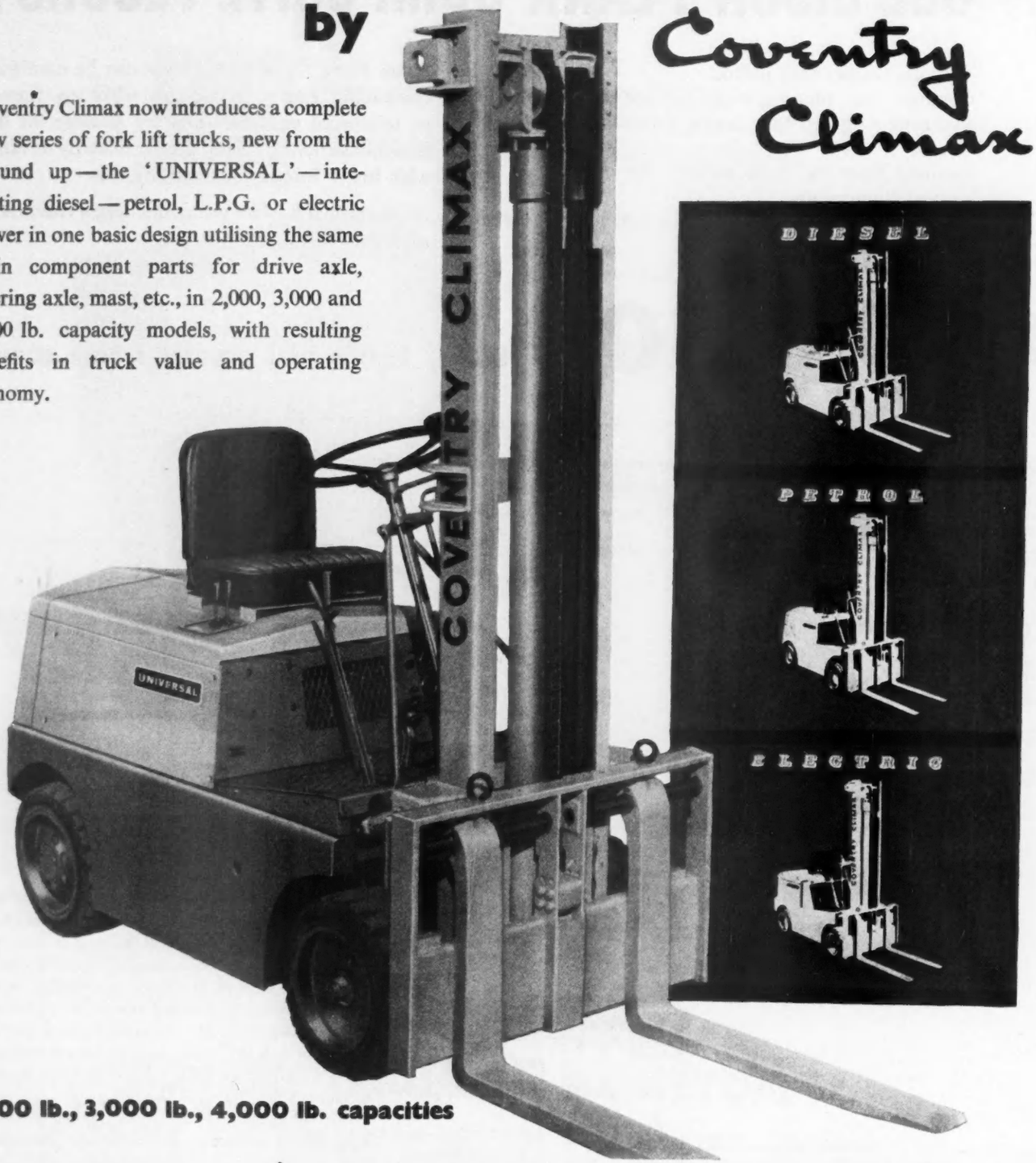


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# THE ENGINEER

No. 5343 JUNE 20, 1958 VOL. 205

## DESIGN IN ENGINEERING

How very few lecturers on engineering subjects have any ideas to put across ! Plenty of lecturers can put across the technical facts ; and to their brother technologists those facts can prove absorbingly interesting. But usually if any attempt is made at all to express an idea, it is of very little value and easily derivable anyway from the technical facts. Because, therefore, in delivering the Lord Westwood Memorial Lecture, before the Institution of Engineering Designers, Mr. Hugh Clausen had a real message to convey the whole character of the event was decidedly different from the usual. We reprint extracts from the lecture on another page. Mr. Clausen believes that the importance of design and of designers in engineering is insufficiently recognised and he links up the failure of our times to give sufficient respect to designers with its apparent inability to appreciate the cultural values and effects of engineering upon our civilisation.

It is as astonishing to us as it clearly is to Mr. Clausen that our generation seems " to have specifically excluded engineering matters from what is known as culture or the arts." Moreover, amongst highly industrialised nations we are almost alone in doing so. In the United States, for example, few people have any doubt about the nature of the roots of their civilisation. Their lives, it is well recognised, are constantly influenced by engineering advances. In Germany it is much the same. To be able to place the abbreviation Dr.-Ing. before one's name is to ensure that one will be respectfully regarded by the community. But, peculiarly, in the very country which was the cradle of modern engineering, that technology is not highly regarded. Those who claim in this country to be leaders in culture and in appreciation of the arts only too often have very little knowledge of science and none at all of technology. Pure science, of course, though incomprehensible, is regarded by them as respectable. But there is deemed to be something artisan and rough about technology. This failure to appreciate that all our modern habits of living and many of our ways of thinking are founded upon the existence of engineering products and hence upon the existence of people creative enough to design them, makes itself evident sometimes in odd ways. For example, we call a certain museum in South Kensington, London, the " Science Museum." It is unquestionably a misnomer. For it is in fact predominantly a museum of applied science and would therefore be termed in any other country a museum of technology. Again, that museum is almost blind to the cultural effects of the objects it puts on view. It sticks to technicalities. If you want to study culture it seems to say, then you should cross the road and enter the Victoria and Albert Museum. The Americans make no such mistake. In such a museum as that at Chicago, the message is preached to the visitor that his whole life is dependent on the work of engineers ; that this is indeed the culture of the twentieth century. Nor have the Germans any doubts. Their learned societies are almost as ready to discuss the cultural values of engineering as its technical values. And the Russians, to judge by their pavilion at Brussels, have almost overlooked that there are cultural values in anything but technology !

In Hugh Clausen's view, this country is now producing fewer good designers than it should. He insists that it is the fault of industry because there is too little technical representation on higher management and the creative aspect of design has been granted too little attention. For our part, we feel less depressed than Mr. Clausen. Yet he is not without support. Lord Hives, for example, insisted in a paper he presented before the Institution of Production Engineers and from which Mr. Clausen quotes, that research, development and testing are all more " glamorous " to university graduates than design ; and that industry is largely responsible through giving insufficient encouragement to create first-class designers. But have not the universities some responsibility, too ? At least one contributor to our columns (we recall an article by Ewen M'Ewen some years ago) has pointed out that university engineering courses ought surely to offer more encouragement to undergraduates to develop the creative qualities so necessary in a designer.

## A LAGGING NETWORK

Too frequently for our comfort, we hear the complaint that the telephone service in this country lags technically behind what is provided elsewhere, or behind what it is thought fitting that a leading industrial nation should by now enjoy. Yet the Postmaster-General publishes his pride in the efforts of the G.P.O. to automatise telephony still further, and at least the appearance of reduced charges to the user has been achieved in certain instances : this, in a nationalised industry, is an accomplishment too rare for us to disregard it, and proper praise should not be withheld. Yet, among those countries that possess more than 25,000 telephones apiece, the United Kingdom ranks second in the number of instruments installed and *thirty-fourth* in the attainment of automatic operation. Switzerland has automatised her service to the extent of 99·6 per cent, the Netherlands 96·1 per cent, Venezuela manages 94 per cent, and Austria 87·7 per cent. But in the country that led the industrial revolution the proportion is only 78·2 per cent. No wonder that the telephone is less popular here than abroad, for the deficiencies of the human links are only too well known. To quote the annual report of the Telecommunication Engineering and Manufacturing Association, " there is plenty of room for expansion, and indeed much slack to be taken up before we can claim our rightful place in the hierarchy of telephone users." The report goes on to suggest that " our rightful place " was lost because of " the intense efforts in other directions we were called upon to make during two world wars," but it does so on a page where the proportion of automatic

services in the two Germanies is given as 96 and 92·2 per cent respectively !

The chairman of the T.E.M.A., Sir Thomas Eades, sums up the situation neatly in his foreword to the report. Telephonically speaking, he says, the year 1957–58 was very eventful, for technical co-operation between the G.P.O. and the industry continued, and a start was made on a process that should end in the possibility of dialled connection between any two points in the country. But, as Sir Thomas goes on to complain, the reduction of about £5,000,000 in the Post Office estimates for 1958–59, to be followed a year later by a reduction of £10,000,000, falls hardly on a service that must be planned so many years ahead. We sympathise when he pleads that the telephone network should be among the last of public enterprises to be cut.

## THE STATE OF THE RIVER TYNE

Most rivers in their tidal reaches are exempt from the provisions of the River Pollution Act. The state of one such tidal reach—that of the River Tyne—was described on Wednesday by Dr. T. L. J. Coxon, the Medical Officer of Health of the Tyne Port Health Authority, in a paper entitled " River Pollution in Tidal Waters," which he presented at a meeting of the Royal Society of Health in South Shields. Dr. Coxon's comments are frank and outspoken, but the objective, scientific presentation of the condition of the river which he gives, makes an even more forceful impression than his comments on it, just though they are. Here are some of the facts which he gives. Over a distance of 12 miles there are 300 sewage outfalls into the river, where sewage is discharged without any form of treatment ; the total quantity of crude sewage thus discharged in a year is given as 10,000 million gallons. The Tyne Improvement Commission keeps a 30ft channel dredged for navigation, and removes about 26,000 tons of sludge by dredging each year ; a considerable amount of this sludge is sedimented sewage. Massive disturbance of sludge under the prevailing anaerobic conditions, such as by the propellers of vessels manœuvring alongside Newcastle Quay, occasions most nauseating conditions. No fish at all can live in the lower Tyne, and medical opinion holds that broncho-pneumonia or intestinal infection is a greater risk than drowning to anyone who falls in the river !

Dr. Coxon points out that " these are ideal conditions which, given appropriate weather, are capable of causing widespread disease." Yet so far no epidemic has occurred. The effect of a grossly polluted river on the health of the surrounding population is very difficult to assess, he considers, but he seems to be of the opinion that Tynesiders have had good luck up to the present. He also affirms that there is a hard core of influential opinion on Tyneside opposed to financial outlay on the scale needed to remedy pollution of the river, and there is danger that a partial scheme might be adopted as a " face saver."

Although Dr. Coxon's paper confines itself to the Tyne, it is, of course, evident that similar conditions prevail in many other estuaries. Recent researches into pollution in the Thames have shown anaerobic conditions at London Bridge. Thus, considerable capital outlay is called for at other estuaries as well as Tyneside. But such expense is likely to prove fairly modest in relation to the total rates levied in the areas concerned. The benefits of a clean and wholesome river are not readily expressible on a balance sheet, but are nevertheless real and desirable. In an age of constantly improving conditions in industry and social life and of increasing command over natural phenomena and resources, the dirty habits which are part of the traditions we inherited from the industrial revolution should surely be made as obsolete as other social blights of that period have become.

## ISLAND ENTERPRISE

A tomato, we understand, is composed very largely of water. Guernsey exports about 50,000 tons of tomatoes to this country every year. They are grown largely in heated " vineries " by modern, intensive, methods of cultivation, yielding high crops and, of course, using a great deal of water. The island is fortunate in the extent of its well-water supplies, but these, apparently, are now stretched to a point where serious droughts, such as have occurred seven times in the past 118 years, would be, in the words of the president of the Guernsey Water Board, " a catastrophe that could reduce us to the level of Malta, after centuries of independence having to go cap in hand to the Home Government to get us out of troubles that came upon us through our own lack of foresight."

The novel solution now being considered is to evaporate sea-water to augment the supply, as described on page 901 of our last issue. We have become accustomed to hearing of enormous evaporators installed in the desert oilfield states of the Middle East (the alternative plant operating by electro-dialysis is at present economically competitive only for brackish water). We are also aware that a half-million gallons a day distillation plant, supplied by G. and J. Weir, Ltd., has just started operation in the island of Aruba (offshore from Venezuela), and that other similar plants providing power as well as fresh water are in course of installation elsewhere in the West Indies and Caribbean. But one so near home is much more startling. The lesson to be learned from it may be equally near to us. Many water supply concerns on the mainland are coming nearer to the situation in which the Guernsey Water Board finds itself, and if industrial and economic activity continues to increase, the experience gained by erecting and operating this plant may be of value, therefore, to other water undertakings. The economics of the plant will certainly be studied with interest by all concerned with water supply.

## JUMPING TO CONCLUSIONS

In our issue of May 23 we described briefly some inferences from recent work with the Harwell apparatus known as " ZETA." A more detailed account of the matter has now been published in *Nature*, and Sir John Cockcroft has spoken a few reassuring words for those who seem to be lapsing into despondency as swiftly as they soared earlier into prophecies of the millennium. One of the difficulties of work under a spotlight is that every twist and turn is not only visible, but is actually focused upon by every surrounding eye. The researchers at Harwell have been embarrassingly lionised by a largely uncomprehending public for a single step in a long programme of work, and it would be a pity for them now to suffer criticism because their successful experiment has been shown in one respect to hold less dramatic implications than was at first thought.

As we have already explained in our columns, it has now been demonstrated that most of the neutrons produced from nuclear fusions in " ZETA " are not the product of thermonuclear reactions : they arise principally from the encounters of 20 keV deuterons with much less energetic deuterons. It was difficult at first to distinguish between the different ways in which neutrons are born in " ZETA," and it is understandable that in the first flush of enthusiasm Sir John Cockcroft should have felt so

nearly certain of the thermonuclear origin of these neutrons. It should be noted, however, that in the paper by Thonemann, Butt, Carruthers, *et al*, the men working on the project, no more was claimed than that the nuclear reaction rates observed were not inconsistent with what was expected from a fusion process. The major achievement reported was the relatively lasting stability of the pinch in the torus. In fact, the discovery that the neutrons so far observed were not conceived thermonuclearly does not reduce the significance of the work done. The yield of thermonuclearly born neutrons cannot in any case be large at this stage in the development of the apparatus, and whether they are present in a more or less minute quantity is not very important.

An extraordinarily interesting piece of fundamental research has taken about seven years to reach a point at which certain unexpected results have been obtained ; a torus designed to attain about 1,000,000 deg. Cent. has reached five times that temperature, and energetic deuterons have been found to arise from unknown sources. What can be less surprising than that such surprises should occur ? Else why the need for experimental research ? We deplore any withdrawal of reasonable confidence in what is being done now at Harwell, and we do not share in the disappointment that has been expressed in more mercurial quarters.

## WOMEN AS ENGINEERS

There has just been issued as a pamphlet a report on " Women in Engineering." It is the report of a committee set up under the auspices of the Manchester College of Science and Technology to inquire into the employment of women scientists and technologists in the engineering industry. The inquiry was restricted to the Greater Manchester area and all the major engineering firms in the area received questionnaires and about one-half replied. It is not surprising to us, and we doubt whether it has proved surprising to the committee, that the report turns out to be of rather little value. For the truth is that there are very few engineering firms in this country which have sufficient experience of employing or training women graduates to be able to make any informed comment about the matter. That, far from unexpected, fact is, of course, brought out in the report. The other fact brought out in the report is consequential. Opinions range from that which is frankly sceptical of the value of women engineers to that which holds there to be no substantial difference between the professional usefulness of men and women. The comments and conclusions with which the report ends thus seem to us to be founded on wholly insufficient grounds. Nevertheless, they also seem to us to be far the most valuable paragraphs in the report. For whereas those firms which replied to the questionnaire almost invariably expressed a wholly male opinion, the female sex was strongly represented on the committee and is in those comments and conclusions therefore able to express some female opinions. Men, even after they have married them, tend to think of women as tender plants. Thus firms lacking experience of the employment of women engineers tend to assume that their usefulness would be restricted, that they could not undertake " heavy " work or " dirty " work or be placed alongside and compete with men, much less be put in charge of men and so on. In fact, and significantly, the only firm with extensive experience of training women finds them to be entirely satisfactory apprentices, undergoing precisely the same course as men and not turning a hair at any part of it ! Pertinently, the very last paragraph of the report, perhaps written personally by Miss Anne G. Shaw, who headed the committee, opens with the sentence " There remains the outstanding question whether, in fact, young women want to embark on careers in engineering." Do they ? For if they do we very much doubt whether any merely male idea that the training experience for some branch of engineering makes it unsuitable for women will have the slightest influence.

## A RAILWAY CONVERSION OPPORTUNITY ?

One of the more obvious things for the Railway Conversion League to press for is the conversion of abandoned railway lines into roads. For thereby a practical test would become possible of its ideas, which have led to so much discussion in our correspondence columns. The news that the railway formerly known as the Midland and Great Northern Joint Line (see page 938) is to be closed down suggests, therefore, that immediate action should be taken. Unfortunately, however, the line is for the most part not very suitable for conversion. Of its route mile length of 180 miles only 65 miles, we understand, are double track, not all in one piece. Nevertheless, consideration should surely be given to the conversion of lengths with sufficient widths to become roads. Is the British Transport Commission the appropriate body to study whether conversion would be practicable and worth while ; or should the Ministry study that matter ? At least, an opportunity is provided for the League to make its presence felt and, should conversion be deemed reasonable, it should prove possible to determine some facts about costs of conversion and traffic-carrying capacity thereafter. As the correspondence in our columns has shown, actual experimental data are so lacking that there is little for those with open minds to bite upon.

## The Engineer — 100 Years Ago (JUNE 18, 1858)

### " An Ice-Making Machine "

" The following is a description of an ice-making machine, the invention of Mr. Harrison, of Geelong, Victoria. It has produced ice at the rate of from 5,000 lb. to 6,000 lb. per day ; and, when permanently fixed and regularly worked, it is expected that the inventor's estimate of 8,000 lb. to 10,000 lb. of ice per day will be accomplished. The refrigeration is produced by the evaporation of ether in a vacuum ; and the peculiarity of the invention consists in the arrangements for evaporating the ether at a low temperature, and condensing it at a higher, precisely the reverse of ordinary evaporating processes. The ether is contained in air-tight vessels, relieved from the pressure of the atmosphere. The cylinder in the centre of the apparatus is fitted with valves, so that each stroke of the piston withdraws a quantity of ether vapour from the left-hand vessels, and forces it into a condensing vessel on the right-hand.

" Where the vapour is raised an intense cold is produced ; where it is condensed, a corresponding degree of heat is evolved. The ether, after resuming the liquid state, returns by a self-regulating valve to the evaporating vessel, and the process thus continues uninterruptedly, without requiring any attention, and without the slightest waste of material. Indeed, as the pressure inside the vessels is less than the outside atmospheric pressure, it is an impossibility that any ether can escape. The evaporating vessel is simply a tubular boiler. This is not a misnomer, for the ether actually boils in it at a temperature (if required) 50 deg. below the freezing point. The cold produced is utilised by means of a stream of salt water, which does not itself freeze at the temperature required for ice-making but carries the cold to the vessels containing the fresh water for conversion into ice. This part of the apparatus consists of a trough 20 feet in length, fitted with 61 freezing moulds, over the outside surfaces of which the cold salt water circulates in a continued stream."

# Reactor Irradiation Techniques

*We reproduce here, in a slightly abridged form, a paper read by B. S. Hickman* at the Symposium on the Peaceful Uses of Atomic Energy, recently held in Sydney, Australia. The author deals with the problems encountered in precise investigations of neutron irradiation of materials. Various experimental techniques which have been developed to overcome these problems are described with particular reference to techniques which could be used in the Australian Atomic Energy Commission's research reactor "Hifar."*

THE ever-increasing demands of reactor design engineers for materials which will withstand high doses of irradiation under extreme conditions means that irradiation damage investigations must now play an extremely important part in any atomic energy programme. Of equal importance in this field is basic research, not only to obtain data on the mechanisms of irradiation damage, but to assist in a better understanding of the physics of the solid state.

With the commissioning of the Australian Atomic Energy Commission's research reactor, "Hifar," facilities will become available, both to the Commission's Research Establishment and to other research organisations, for investigations of the effects of neutron irradiation on the properties of materials. The purpose of this paper is to outline the problems encountered and to describe techniques which have been developed for similar reactors overseas.

Irradiation damage investigations can be divided broadly into two types on the basis of techniques used and difficulties encountered.

*Investigations on Fissile Materials.*—This includes small-scale investigations on fuel element materials and the testing of full-scale prototype fuel elements in complex "loops." The latter type of investigation will be mentioned only briefly, although the problems encountered are generally the same as for the small-scale work.

*Investigations on Non-Fissile Materials.*—Because of the lower heat generation and generally lower hazards associated with this type of experiment, the techniques used are often simpler than in the fissile material experiments.

## Facilities Available

The types of facility available for the insertion of experiments vary considerably with the type of reactor. In "Hifar" the facilities consist of horizontal and vertical thimbles which are situated either in the heavy water moderator adjacent to the fuel elements, or in the graphite reflector. These facilities, together with the neutron fluxes available, are shown in Table I; the fast fluxes given in the last column are very approximate. In the designation, the number refers to the diameter of the hole, the V to vertical holes, and the H to horizontal holes.

* Australian Atomic Energy Commission Research Establishment.

The fast flux in these facilities is not sufficiently high for some work on non-fissile materials where high neutron doses with energy greater than 1 MeV are required. In these cases a neutron "converter" must be used; this generally consists of a hollow fuel element. Fission in the fuel enhances the fast flux in the centre at the expense of the thermal flux.

In "Hifar," it is hoped that some hollow fuel elements with a 2in diameter central thimble will replace some of the standard fuel boxes to provide a fast neutron irradiation facility. Flux above 1 MeV in this facility will be approximately $3\times10^{13}$ $n/cm^2/sec$.

## Design Problems

Limitations are often placed on the design of experiments by the small diameter of experimental holes, by the distance of the high flux region in a hole from the face of the reactor and by the limited amount of space usually available outside the pile shield in the immediate vicinity of the experimental hole. This limitation becomes particularly serious when in-pile measurements, such as the rate of strain in a creep test, must be made.

A major problem encountered in the design of experiments is that of removing the heat generated by various processes in the sample and associated apparatus while allowing control of the temperature in the specimen. Heat production in fissile materials by fission is given approximately by:

$$H=\frac{\phi\Sigma_f V}{3\cdot1\times10^{10}}W$$

where

$\phi$ = mean flux in sample.

$\Sigma_f$ = macroscopic cross section for fission.

$V$ = volume of sample.

This heat production can reach very high levels, e.g., 4½kW per gramme of $U^{235}$ in a flux of $10^{14}$. Accurate determination of the mean flux in a specimen for this calculation is difficult. The undisturbed flux in the experimental thimbles is reduced by absorption in the sample and apparatus and by streaming along the thimble. Several empirical methods (Lewis, 1954) have been used for estimating the flux depression, but the results are not accurate, particularly for strong absorbers, e.g., highly enriched fuel samples.

Table I—*Irradiation Facilities in "Hifar"*

| Designation | Number | Position | Peak thermal flux | Peak fast flux>1 MEV |
|---|---|---|---|---|
| 6V | 4 | In heavy water | $5–6\times10^{13}$ | $2\cdot5\times10^{11}$ |
| 4V | 5 | In heavy water | $3\times10^{13}$ | $1\times10^{11}$ |
| 2V | 9 | In heavy water | $7–9\times10^{13}$ | $1\times10^{13}$ |
| 6VGR | 6 | In graphite reflector | $3\times10^{13}$ | $2\times10^{9}$ |
| 4VGR | 2 | In graphite reflector | $3\times10^{13}$ | $2\times10^{9}$ |
| 10VGR | 2 | In graphite reflector | $3\times10^{13}$ | $2\times10^{9}$ |
| 10H | 1 | In heavy water | $7\times10^{13}$ | $2\times10^{11}$ |
| 6H | 1 | In heavy water | $8\times10^{13}$ | $6\times10^{11}$ |
| 4H | 6 | In heavy water | $6\times10^{13}$ | $4\times10^{11}$ |
| 2 tan | 1 | In heavy water | $9\times10^{13}$ | $4\times10^{11}$ |
| 6HGR | 10 | In graphite reflector | $1\times10^{13}$ | $2\times10^{10}$ |
| 12HGR | 2 | In graphite reflector | $7\times10^{12}$ | $2\times10^{10}$ |
| 4HTC | 9 | In graphite thermal column | $7\times10^{10}$ | $4\times10^{8}$ |

Heat is produced in materials by several processes other than fission:

(i) Capture $\alpha$ heating due to $(n, \alpha)$ reactions.

(ii) Capture $\gamma$ heating due to $(n, \alpha)$ reactions.

(iii) $\gamma$-heating due to exposure to the pile $\gamma$ flux.

(iv) Radioactive decay heating.

(v) Heating due to fast neutron scattering.

The relative importance of these effects varies between different materials—for instance, for light materials such as carbon or beryllium the heating due to fast neutron scattering is predominant. Knowing the pile neutron and $\gamma$ flux, heating due to these effects can be calculated. Experimental measurements have been made in the U.K. reactor, "Dido" (which is identical to "Hifar") and the expected heat production in various materials in several positions in "Hifar" are given in Table II.

With very highly rated experimental reactors, such as the United States Atomic Energy Commission's Engineering Test Reactor in Idaho, this heat production can be as high as 50W per gramme in the core.

Table II—*Heat Production in Various Non-Fissile Materials in 2V, 4V and 4VGR Positions in "Hifar"*

| Material | Heat production, watts per gramme | | |
|---|---|---|---|
| | 2V | 4V | 4VGR |
| Beryllium | 0·65 | 0·10 | 0·015 |
| Carbon | 0·71 | 0·10 | 0·014 |
| Aluminium | 0·75 | 0·15 | 0·02 |
| Iron | 0·67 | 0·093 | 0·014 |
| Zirconium | 0·72 | 0·088 | 0·012 |
| Lead | 0·82 | 0·11 | 0·017 |

Removal of heat generated by any of the above processes can be accomplished in several ways:

(i) Direct insertion of the experiment into the main reactor coolant stream (gas or water). The disadvantage of the method is that any escape of activity from the experiment could contaminate the whole of the reactor circuit.

(ii) For low heat outputs, the experiment can be suspended in an experimental thimble, conduction and convection to the main coolant being used to remove the heat.

(iii) Forced cooling using a liquid or gas circuit distinct from the main reactor circuit. This system can vary in complexity up to a full-scale fuel element testing loop when the coolant would be the same as in the reactor system being investigated. Gas, high-pressure water, liquid metal and organic liquid in-pile loops have all been operated in various reactors overseas (see, for instance, Martinec, 1957, and Francis, 1955). For simpler experiments gas or water cooling at low pressures can generally be used. If a guaranteed cooling circuit is required (i.e. if cooling of the experiment during reactor operation is essential to the safety of the reactor), adequate instrumentation must be provided to trip the reactor if the supply fails, and a standby supply should be provided.

## Temperature Control

Materials must often be irradiated at elevated temperatures, and use can be made of the various forms of nuclear heating to attain these temperatures. A thermal barrier is placed between the sample and the coolant, the thickness and conductivity of the barrier being chosen so that the calculated heat production under irradiation will raise the temperature to the desired level. A gas gap, the most satisfactory barrier, has been used successfully in the U.K. (Plail, 1956), and will be used in "Hifar" for investigations of the stability of fuel materials for use in a high temperature gas cooled reactor. For

highly rated samples, it is usually necessary to provide a greater heat transfer area at the gas gap than the specimen surface area, or the width of the gas gap becomes prohibitively small. This greater transfer area may be accomplished by immersion of the samples in liquid sodium or sodium potassium alloy. The above methods have two limitations :

(i) Uncertainties in calculation of the heat output mean that the desired temperature cannot be obtained with an accuracy of better than $\pm 20$ per cent.

(ii) Variations in neutron flux in the experiment due to reactor control arm movement and the insertion and removal of other absorbers in the vicinity, e.g., other experiments, will result in a variation in the specimen temperature over the irradiation period.

For high temperature irradiation of samples with low heat output, these disadvantages can be overcome to a certain extent by the use of radiation cooling across a wide gas gap of low conductivity, in which conduction and convection can be neglected. This method has the advantage that the temperature varies as the fourth root of the heat output, and hence is not very sensitive to changes in heat output or inaccuracies in calculation.

If more precise temperature control is required, some form of auxiliary heating must be used. In its simplest form, this consists of a resistance winding of small heat output compared with the nuclear heating. The thermal barrier is chosen so that the specimen temperature with nuclear heating alone would be somewhat lower than the desired temperature. The auxiliary heating is then used to raise the temperature to the required level, and to cater for variations in the nuclear heating during irradiation.

This method, however, results in temperature cycling at reactor shut-downs. In some cases, e.g., irradiation of uranium metal, this may be undesirable because the thermal cycling will itself produce damage which could over-ride any irradiation effects. In this case, greater auxiliary heating must be applied, not only to control the temperature during irradiation but also to maintain the temperature during shut-downs.

An apparatus of this type was developed at the Atomic Energy Research Establishment at Harwell, by the author, for irradiation of small samples of fuels (up to 1cm in diameter by 2cm long) with a heat output of 500W. The main problem in design of this rig was to provide a path to conduct the fission heat away during operation, but at the same time to incorporate sufficient auxiliary heating in the very small space available to maintain the temperature at reactor shut-downs.

The specimen was immersed in liquid sodium in a double-walled stainless steel can, which was a push fit in a finned zirconium furnace former. This was surrounded by a zirconium tube, which was separated from a water cooled aluminium jacket by a helium-filled gas gap. Nichrome furnace windings of 800W–1000W rating were supported between the zirconium fins by ceramic supports. During fission, the heat was conducted down the zirconium fins and across the gas gap. On shut-down, a controller increased the furnace input to maintain the required temperature.

To cope with rapid reactor shut-downs a fast response furnace controller was required. After investigating several systems, a magnetic amplifier operated from a potentiometric recorder controller was adopted. The system has been found to work very satisfactorily, and even at " scram " shut-downs, when the pile power is reduced to a low value in a few seconds, temperature cycles of only 10–20 deg. Cent. were observed, and samples could be irradiated at controlled temperatures in the range 400–800 deg. Cent.

For basic investigations of irradiation damage in metals where some induced changes anneal out at ordinary pile temperatures (50–150 deg. Cent.), it is often desirable to carry out the irradiation at reduced temperatures. Irradiations at liquid nitrogen temperatures have been carried out by A.E.R.E., Harwell, in " Bepo," and by Oak Ridge National Laboratories in their X10 reactor, and recently Oak Ridge have developed a helium cryostat for irradiation at temperatures down to 20 deg. K. (Coltman *et alia*, 1957). Nuclear heating in these reactors is low—of the order of a few milliwatts per gramme. However, it is considered that the problems involved in carrying out these experiments in " Hifar," whilst more difficult than the above cases, due to the higher heating, are not insurmountable.

## Materials of Construction

There are three main limitations on the use of materials for irradiation apparatus :

*Neutron Absorption.*—Excessive neutron absorption in the apparatus will not only reduce the effective flux in the sample, but also will reduce the excess reactivity available in the reactor. Wherever possible, materials with a low neutron capture cross section should be used in the construction of apparatus, but this requirement has to be related to their suitability in other respects, e.g., strength at elevated temperatures. Aluminium and magnesium are useful for low temperature work. For higher temperatures, hafnium-free zirconium can be used, but it is in limited supply and must be protected from oxidisation, and often stainless steels or Nimonic alloys must be used for part of the assemblies.

*Induced Activity.*—To facilitate handling of the experiment after irradiation and to reduce the problems of disposal of the assemblies, the induced activity in the apparatus should be kept to a minimum. Even very small quantities of some materials with high capture cross sections and medium to long half-lives, e.g., cobalt and tantalum, can result in high induced activities. For this reason, alloys should be chosen with care, and wherever possible high purity grades of metals, e.g., aluminium, should be used. For instance, cobalt impurities in the nickel in stainless steel account for a large proportion of the long-lived activity induced in stainless steel, and special low-cobalt stainless steels are now being manufactured in the U.S.A. for use in reactors.

*Stability Under Irradiation.*—Generally, the only limitation this places on the use of materials is on those plastics and organic materials which are unstable under irradiation. This is particularly important in the case of insulating materials, and pure ceramics should be used for this purpose.

In some special cases, other factors must be considered, e.g. :

(i) The change under irradiation in the brittle-ductile transition temperature of a steel used in a high pressure water loop may cause failure of the pressure shell.

(ii) The large change in dimensions of graphite precludes the use of this material where close tolerances must be maintained.

## Safety

Safety of the research reactor is of prime importance at all times, and the designs of all experiments must incorporate precautions against every foreseeable hazard. Any materials likely to lead to a hazard must be adequately contained, e.g., liquid sodium and quantities of fission products are generally contained inside a double-walled can. Any conditions likely to endanger the reactor or the operating personnel must be adequately covered by instrumentation, and may need to be wired into alarms, and sometimes into the reactor trip circuit. To minimise the reactor trips which cause loss of operating time, the number of circuits tied with the reactor trip circuit should be kept to the absolute minimum consistent with safety.

The need for complete reliability in these circuits, and indeed for all equipment associated with in-pile experiments, cannot be over-emphasised. The problem is often made more difficult because non-standard components have to be used, and also because standard components are often found to have insufficient reliability for use in this work. Hence, it is essential that all components should be thoroughly tested before use, and that the completed assemblies should be tested, as far as possible, before insertion in the reactor.

It should always be borne in mind that the irradiated apparatus will have to be handled remotely after irradiation, both during removal from the reactor and during removal and examination of the samples. Hence, the design should include all possible features which will allow easy handling and dismantling by remotely operated tongs or manipulators.

## Flux Measurement

It is usually desirable that the integrated flux which an irradiated sample has received should be known fairly accurately. This can be obtained in three ways :

(i) Calculation based on a knowledge of the undisturbed flux in the irradiation position before insertion of the experiment. As mentioned earlier, this is not very satisfactory owing to variations in the flux over a period of time with movement of control arms and changes in the loading of the reactor, and to uncertainties in the calculation of the flux depression caused by the experiment.

(ii) Analysis of the irradiated samples. In the case of fissile material this is easily carried out, using gamma-spectrometric techniques to measure the quantities of some fission products whose yields are known fairly accurately. The method can also be used for non-fissile samples by measuring induced activities or the quantity of a particular isotope produced by the irradiation.

(iii) Use of a suitable flux monitor placed adjacent to the sample. For thermal flux measurements cobalt in the form of wire can be used—the induced $Co_{60}$ activity being measured after irradiation. Sometimes in order to obtain an easily handled sample of low activity, the cobalt is diluted by dispersion in another material, e.g., high purity aluminium.

For monitoring fast flux, no really suitable technique has been developed. The reaction $S^{32}(n, p)P^{32}$, which has a threshold of about 1 MeV, has been used (Martin, 1956), the activity of the beta emitting $P^{32}$ being measured. However, the short half life (14·3 days) of the $P^{32}$ means that the induced activity approaches saturation after a few weeks' irradiation and is not suitable for longer irradiations.

The fast fission reaction which occurs in $U^{238}$ at neutron energies greater than 0·6 MeV is another possibility which is being investigated. The monitor must be shielded from thermal neutrons by a suitable material, e.g., cadmium or boron, to prevent interference by thermal fission of $U^{235}$ or $Pu^{239}$.

Care must be exercised in the placing of the monitor with respect to the specimen.

Ideally, the monitor should actually be inserted in the specimen, but often this is not possible and an uncertainty is introduced if the monitor is placed adjacent to the specimen, because it is not known to what extent the flux at the monitor is affected by the flux depression due to the sample.

### Temperature Measurement

Thermocouples have been found quite satisfactory for temperature measurement provided suitable insulating materials are used—mineral-insulated couples such as "Pyrotenax" are the most satisfactory. There is no evidence that the neutron flux affects the characteristics of the thermocouples in any way.

### References


Coltman, R. R., *et al.* (1957), *Rev. Sci. Inst.*, 28, 375.
Francis, W. C. (1954), U.S.A.E.C. Report IDO-16189 (Unclassified).
Lewis, W. B. (1955), *Nucleonics*, 13, No. 10 : 82.
Martin, D. G. (1956), A.E.R.E. Report M/M 138 (Unclassified).
Martinec, E. C. (1957), *Nucleonics*, 15, No. 4 : 73.
Plail, O. S. (1956), *Journal Inst. of Metals*, Bulletin, October, 1956, 122.


# Engineering Design

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*Below we publish extracts from the Lord Westwood Memorial Lecture, delivered to the Institution of Engineering Designers on June 12. The author stresses that engineering is as much part of the culture of this age as anything else, and that our tendency to exclude it makes us the poorer. He insists also that the art of engineering, particularly the art of design, is being relatively neglected.*

### Engineering Design—The Unseen Basis of Our Civilisation

ENGINEERING—in the broad sense—is the foundation of all industries and most human activities. Wherever one starts, whether it be silk stockings or shipbuilding, microscopes or motor lorries, we are back, in one or two stages of dependence to the design of the machine tools used, the basic engineering on which our civilisation is grounded.

Let not the man of classical or literary education and culture dismiss engineering as dry, materialistic, technical and a non-essential ingredient of a high civilisation. Leonardo da Vinci advertised himself as an engineer, but there is no definite line of demarcation between his engineering drawings and his most highly developed examples of what we now call Art. The one merges gradually into the other through a wide range of studies of form and pattern.

If our present material achievements are—as has been stated—lacking in the higher human qualities, in vision, or permanent value, whose fault is it? Surely that of people of higher appreciative powers for not taking part in the activities concerned and so raising their standards.

In a review of the Thomas Telford bicentenary exhibition held by the Institution of Civil Engineers, I was struck by the remark that Telford would have been utterly puzzled by the debates in this age about giving engineers a smattering of the humanities in their early training to avoid the evils of over-specialisation. To such a man there could be no such issue to discuss. For him engineering was a particular form of expression of the cultured man, an essential part of a liberal education.

We—in our present age—for some reason which I, for one, completely fail to understand, seem to have specifically excluded engineering matters from what is known as culture or the arts. Our education, our civilisation, our culture and, what is perhaps even more telling, our national economy and prosperity, are the poorer as a direct consequence. I am fully convinced that our present economic difficulties—of which we are now only at the beginning—are due more to our neglect of giving proper attention to engineering design at an appropriate level in the major organisations concerned—government departments, industrial directorates, and professional institutions—than to any other single factor.

To-day, the drawing-office in many engineering concerns seems to have been pushed out on to a limb, a side branch, instead of being in its proper place as part of the main trunk, with its roots seeking nourishment in the fields of research and its branches supplying the fruits of production. Drawing is the only medium of transfer from thought to material; nothing can exist unless it has been designed first. The place where quality is injected into the product is on the drawing board, and the instrument used for injecting it is a pencil.

Lord Hives, giving the 1957 Lord Nuffield paper to the Institution of Production Engineers, said:

"The problems of production start when the first lines of the design are put on paper, so, in my definition, the designer is a member of the production engineers.

"I strongly disagree with the suggestion that is sometimes made that you make an article and develop it and then hand it over to another group of people to 'productionise' it. In the case of the particular products I have been connected with, this would lead to disastrous results. It is essential to use all the talent and knowledge available to make certain that the original designs are practical from a production point of view.

"It can be proved that this procedure does not slow up the job in any way. It means that a bit more thought has to be given to the original designs which will eventually result in a saving of time. I was brought up in a school where there was a maxim hung on notice boards, both in the works and in the offices, which said 'Think Before, Not After.' It is a simple and wise philosophy which is often neglected.

"This unity of design, development and production is not achieved by an organisational chart; it has to be built in by confidence in and respect for each partner.

"We were all influenced by the creative genius of the company—the late Sir Henry Royce. He was a great believer in doing your development work on the drawing board. He had infinite patience for detail and all his designs were considered from every point of view—production, reliability, stressing, &c. It followed that our best engineers were all designers and worked on the drawing board."

I agree absolutely with Lord Hives that production—or any other kind of engineering—starts on the drawing board and depends on it throughout the whole process, whether as regards the product, the tools with which to make the product, or the tools to make the tools to make the product. The drawings are the only clear and unambiguous definition of what is going to be produced. I do not mean that the drawing board is the only place where attention is needed. Quality may be applied there but missed in the product owing to faulty workmanship or manufacture, but if quality is not inherent in the drawings no other activity can make up for its absence there. For such cases the only thing is to go back to the drawing board and do it better; and it is here that the highest qualities of vision and human leadership are needed. If they are not there the result is inevitably negative and unsatisfactory.

Our national economic prosperity depends almost entirely on the sale abroad of our manufactured goods to pay for our imports of food and raw materials. The dominating factor as to whether we can sell our goods is not so much a matter of our sales organisation as whether the goods we make are what the customer is interested in and wants, and whether they represent good value for money. These are mainly matters of engineering design, either of the product itself, or of the tools with which to make it.

The prosperity of countries which take their engineering design seriously may be noted. Switzerland, which, like ourselves, must export or die, with no raw materials and practically no home market for anything, owes her very strong financial position to the high quality of her manufactured products—largely a matter of good engineering design—which they take very seriously. Germany, whose returning prosperity after the war has been a lesson to us all, is another example of a nation which has built up a strong national tradition of good engineering design. This, especially when associated with machine tool design, is a very versatile quality, providing the necessary basis for all the industrial arts of either peace or war. Sweden is another instance.

In my visits to the engineering exhibition at Olympia last year the detachment of engineering from life as a whole struck me all over again. The typical modern products of engineering firms were shown, but it was obvious that, in contrast to the motor show, this was a "trade" exhibition. It was barely mentioned in the general press, and the intellectual public took little or no interest in it. There was no hint as to how these fascinating machines came into existence—barring the all too frequent note about manufacturing under licence from some foreign country. There was little indication as to the type of mind or man who does all the creative work and who, in creating these things, was—like Atlas—helping to carry the world on his shoulders.

Even in the scientific and technical press one gets the same impression. One sees articles dealing with the scientific, analytical or experimental aspects, illustrated by formulæ, graphs and tables, perhaps even flow diagrams or key diagrams with gear ratios, but the next thing one sees is a photograph of the finished article, which tells you nothing—except what the thing looks like from the outside. Of the really difficult and important thing, the transformation of ideas into ironmongery, there is usually not a hint. It is apparently inferred that these things just happen by themselves—that there is nothing of real importance in them. So little attention has, in fact, been given to engineering design aspects in the past that the idea is quite widely spread (even among people who should know better, from business executives to university dons) that there actually is

nothing in them, just a routine part of the industrial process which is done somewhere by somebody who is presumably hired and fired like labour on the shop floor.

Some of us have been working for many years trying to explain the serious consequences of our neglect of the creative aspects of industry. At long last, after figures were published of what the Russians were doing, we have started to take things seriously and the cry of the need for producing more scientists and technologists is heard in the land—just as if we were being exhorted to breed more prize pigs ! With this kind of approach the result is not likely to be fruitful. It is not so much that more scientists are needed as that the average well-educated man should take more interest in, and know something about, the basis of his own civilisation. The analogy of our present day with H. G. Wells's idea of a time machine future, in which a degenerate, butterfly, superficial race, the Eloi, lived on the unseen and unappreciated labours of the submerged Morlocks is too close to reality to be pleasant.

It may be said—and I have heard it often enough—that these idealistic notions are of no value, that no one is in business for the fun of the thing. The first aim of industry is to make a profit, and administrative and managerial aspects must always dominate over the technical ones. This is true if one adds " competent " as a qualification to management—if the manager understands his own technology ; but as far as making a profit is concerned, the words of Mr. Peter Drucker (U.S.A.) are significant. In a book on management he says : " The first purpose of a business is to stay in business ; making a profit is a means to that end, not an end in itself." An appropriate follow-on from this comes from Mr. Garner, a director of Joseph Lucas, Ltd., in a paper entitled " Some Problems for the Manager " (1955) in which he says : " Managements in some industries must remember that their product designer is the most important individual in the organisation, in that if he fail there will be no business for the management to operate." Of all the factors that make engineering products saleable, profitable, and worthwhile displaying and advertising, good design —in the broad sense—is by far the most important.

Sir Roy Fedden, in his recent book, says : " It may not always be the best policy to adopt the course that is best technically, but those responsible for policy can never form a right judgment without knowledge of what is right technically." And this knowledge must be genuine first-hand knowledge, not merely derived from listening to other people's opinions.

## Components of Industry—and Their Balance

The four main parts of engineering are : " The Science," " The Art," " The Industry " and " The Finance (or Commerce)." Though divided, they overlap and interlock. They are mutually interdependent. The importance of mutual understanding of outlook and language between the groups needs no emphasis. The relative emphasis on these four separate parts varies very widely from one industry to another, and they are not necessarily coincident with the more familiar classification of research, design, production and sales. They are all normal human activities—people doing things ; and although a common conception among otherwise well-educated people is that what is called " technology " is a dry, soulless, materialistic realm, it is, in fact, nothing of the kind. All human activities develop some kind of philosophy or mystique about them, and technology—with which engineering design is so closely associated that it seems barely possible to separate them—is, I think, best defined as " The Philosophy of Craftsmanship." Like the latter, it always involves the making of, or doing, some material thing rather than the discussion of an idea.

At the moment the balance between the four aspects of industry seems to be rather upset. There has been great emphasis on " management " and " productivity "—broadly the last two aspects—and more recently there has been a drive to emphasise the importance of the " sciences," but a corresponding interest in the " art "—without which the other aspects cannot flourish—has not been noticeable. The " art " does not seem to have attracted the attention of men of corresponding quality and intellectual power to those on the scientific, industrial or financial sides and this, I believe, is the main reason for our present economic difficulties. In my younger days in engineering I was often told : " If you want to get on in the world you must get away from the technical side and get on to the commercial side as soon as you can." This was quite true. The " art " has not been attractive to men of ambition. Let us not be confused by the other word " Art," the one that certain people spell with a capital A. Any creative activity is an art, and engineering design is much more an art than a science. The distinction may not always be clear, but with a science it is usually sufficient to be able to explain and expound it, whereas with an art it is necessary to be able to actually do it. In the case of engineering design this means not only being able to express ideas in words and figures, but also to produce precise detail drawings so that manufacture can proceed without hesitation or doubt.

## Nature of Design—Its Expression and Recording

Design does not lend itself to either mathematical treatment or verbal expression. There seems to be an inevitable tendency for men of great intellectual power to concentrate on what can be expressed in literary, mathematical or symbolic terms, and to neglect what cannot be so expressed. This may be an example of the old jape about the famous Dr. Jowett : " What I don't know isn't knowledge."

A good example of this tendency is the attention given by mathematicians to electromagnetic theory, structures or bridges, continuous beams and the like, and more recently to servo theory, that magnificent new stamping ground for the physicists. By comparison, activities like forging, rolling and pressing processes, or (perhaps the most important of all) machine tool design, have been totally neglected by the scientist, and left to be practised as an art, usually at a rather lower intellectual level. The danger in this is not only the lack of balance between two equally important activities, but also the fact that any art is liable to be lost as there is no medium (other than the thing itself) in which to express the body of knowledge and skill involved. Even the thing itself may not carry the right lesson from one generation to another. The necessity of dealing with problems (which have no known written language) at a high intellectual level is certainly not less than that of other activities which can be effectively expressed in symbolic form. This seems to be an opportunity to call for a better balance—at all levels—between the science and the art of engineering, the scientist and the designer. This is not with the idea of " raising the status " of the designer, but that we might be able to survive as an industrial nation.

Our whole European civilisation has suffered—and still suffers—from this attitude on the part of cultured humanity towards the craftsman, to whom words are almost useless as a medium of expression. Our standard educational pattern can be traced back via the older universities and the theological schools of the middle ages, to the classical philosophers, and particularly to Aristotle, who covered practically all available knowledge of his time. All knowledge, that is, which could be expressed in words or symbols. He neglected, as unworthy of serious consideration, the very highly developed technology of the time as the work of slaves, or at any rate beings of a lower order. This false attitude has continued to the present day.

Once again I quote from Lord Hives's paper :

" The usual university graduate does not take kindly to drawing-office work ; he looks for a more glamorous career in research, development, and testing. Industry is largely responsible ; there is not sufficient encouragement to create first-class designers. The time is past for discussing the merits of a classical or scientific or technological education. Applied science is a part of our life. It is in our homes and in everything we eat or wear, and, above all, we enjoy it.

" To meet the demand for more technically trained people, we shall not have achieved anything if we do this by lowering the standards. It is necessary for the best brains and the brilliant scholars to take up a technical career if we expect to maintain the present standard of living in this country. We cannot expect to compete with the U.S.A. and Russia in numbers, but we must do everything possible to compete in quality."

## Lack of Appreciation of Design—and Its Results

Science has had much attention in recent years ; press publicity as well as more serious thought. Its achievements, e.g. radar, television and atomic energy in various forms have ensured this, but I doubt whether its debt to engineering is fully realised and recognised. Industry, too, has had much attention with all the emphasis on " productivity ! productivity ! " almost *ad nauseam*, without enough thought to exactly what it was going to produce. Finance has had even more attention and dominates the whole picture. The art component, the creative engineering aspect does not seem to get its proper attention. In this part of the activity must be embodied all the science and all the practical experience and know-how of manufacture. In addition, all the users' demands must be fed back into it to be processed before they can be designed and embodied in the product. The interdependence of the four parts of engineering is complex and works both ways. Each depends on the others and each feeds back, or forwards, some of its own attitude and special point of view into the other parts. To be effective, executive or administrative authority must carry with it professional competence in the field in which the authority is exercised.

One of the points I wish to raise is this question of technical representation on higher management, not as I have already said because I want to raise the status of the draughtsman or designer, but because unless professional competence is an essential part of higher managements we shall no longer be able to compete—industrially—with other nations where the synthesis between the four aspects of engineering is better balanced. It

is understandable that the decision must be subject to the point of view of financial profit. Arising from this is the mistaken idea that this is the only consideration, and that if it is given a freed hand all will be well as things will ultimately find their own level, and skill and talent will be automatically rewarded. Unfortunately, things do not work out this way, or only so slowly as to be ineffective. The theory that higher financial management is all, and that creative talent can be hired and fired like unskilled labour, is dangerous. The "Situations Vacant" columns in the technical press show only too clearly that there are just not enough able men to go round. The fault lies entirely with industry in not taking steps to select and train men for the future, and in offering much better rewards for managerial activities than for creative ones.

During my whole time in the engineering world—well over fifty years—there has been a steady drift of men of ability away from the design and creative aspects into finance, administration and management. The result has been a (relative) decline in the quality of the country's products. There has been no actual decline; with rare exceptions there has been a steady improvement all round. However, there are plenty of examples where other countries which formerly looked to us for guidance and example have improved so much faster that we now look to them to show us how to do it. This is inevitable unless the talent available is applied in the proper places. How very difficult it is to convince people who have little technical background or understanding that finance should be the servant of industry and not its master!

The Institution of Engineering Designers is only a small and relatively young body and I believe it is not regarded favourably by the older institutions. They seem to consider that its existence may not be really necessary. It would be true if the older bodies had shown a full appreciation of the basic importance of engineering design. This—in my view—they have definitely not done, and neither have the industries nor the educational and scientific bodies concerned.

Machine tool design is basic engineering, the finest school and training ground. All other industries—and civilisation as a whole—depend upon it—and yet the machine tool industry seems to be regarded, both by itself and others, as just a commercial activity. The early work of Maudslay, Whitworth and others gave us a good world lead in the 1850s, but we had already lost it by 1905. We now seem to be unable to catch up, and depend far too heavily on foreign sources of supply because the British equivalent does not exist. In spite of the fact that all our defence material and all industrial progress depends upon machine tool design, I cannot find evidence that, during the last hundred years or so, it has attracted any appreciable attention by such national bodies as the Royal Society, the university schools of engineering, or even the N.P.L. or D.S.I.R. This is a pity, as it would seem to be an ideal national activity, one where the brains and skill involved are everything and the raw materials, by comparison, nothing.

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PLASTICS SHEET CUTTER.—A tool for cutting laminated plastic sheets and similar material has been developed from the slate and asbestos cutters made by the Tubela Engineering Company, Ltd., Ilford, Essex. With this hand tool a small strip of material is removed as the jaws are closed by hand as with an orthodox pair of shears, and the radiused lower shearing blade provides a "lead-out" for the waste strip and it is stated that the accurately controlled blade clearance enables clear cutting to be obtained without damage to a veneered surface.

# Open Days at M.E.R.L.

No. II—(*Concluded from page 888, June 13*)

*This year's open days at the Mechanical Engineering Research Laboratory, near Glasgow, were held on June 4 and 5. Two new buildings, completed last year, house the metrology and heat projects, and the laboratories for the former are thought to be among the finest in the world. A DEUCE computer has just been installed, in the first instance mainly for the preparation of thermodynamic tables. We give below a brief account of some of the interesting work that is going on.*

## PLASTICITY

*Influence of Hydrostatic Pressure.*—In most metal working processes, such as extrusion, rolling, and wire drawing, deformation takes place under high hydrostatic pressure. The effect of hydrostatic pressure on plastic behaviour is being investigated by carrying out mechanical tests inside a pressurised container. Although the object of the work* is to obtain data on the behaviour of materials under high hydrostatic pressure, the quality of the extrusions in some of the more exotic materials has given rise to hope that a technique may be evolved for handling such difficult metals as beryllium. It is thought that a spirally-finned beryllium sheath for uranium fuel rods might be successfully extruded under high hydrostatic pressure, and this could be a boon for the designers of nuclear reactors. A supply of beryllium is still awaited from the U.K. Atomic Energy Authority.

The method of producing high pressure is to intensify a relatively low pressure by applying it to the larger end of a differential-area piston so causing a high pressure on the smaller end. Two such pieces of apparatus are used. The smaller of these employs a monobloc high-pressure chamber and has been operated at pressures up to 85 tons per square inch (12,900 atmospheres). It has been used mainly to gain experience on sealing devices, plungers, high-pressure fluids and pressure gauges. Various seals have been tried as alternatives to the Bridgman "unsupported area" seal which, whilst being perfectly leak-proof, has considerable frictional resistance. The conventional "O" ring, suitably supported by a metal anti-extrusion ring, seems to be most satisfactory. The apparatus has also been used for investigating the strength of thick cylinders, and the resistance of plates to bursting and penetration by high-pressure fluid jets. The larger apparatus has a composite high-pressure chamber with bores of approximately 1½in diameter, and has been used for pressures up to 100 tons per square inch (15,200 atmospheres). In this chamber it is possible to carry out tension, compression, torsion and extrusion tests under a constant hydrostatic pressure. Mechanical tests on a wide variety of materials have shown that, in general, there is a marked increase, with increasing pressure, in the ductility, or the strain to fracture. Tension tests carried out at successively higher pressures show that with a metal like aluminium this increase of ductility with pressure is gradual. Tests with zinc, however, show that there is a critical pressure at which the metal displays a sudden transition from brittle to ductile behaviour.

A compact wire-resistance gauge, wound on a ⅜in diameter by ½in long spool, has been developed for measuring pressure. It has been calibrated up to 42 tons per square inch (6400 atmospheres) in a deadweight tester and the resistance has been found to change linearly with pressure. The gauge should be suitable for use up to any attainable fluid pressure, but calibration has so far been limited by the deadweight testers available. Methods of calibration to higher pressures are being investigated. Electrical leads to the pressure gauge are taken into the container through hard steel conical terminals. These are a lapped fit in hollow conical ceramic insulators which are in turn a lapped fit in a sealing plug.

Novel apparatus for torsion testing under high hydrostatic pressure has been designed. This comprises essentially either an electromagnetic or motor drive, a reduction gearbox, the specimen and a load cell. The whole apparatus is only 8in long and fits inside a 1½in diameter pressure chamber. Load and torque measuring gauges are made by bonding foil strain gauges to thin-walled formers and measuring their change of resistance.

Castor oil, glycerine and pentane are the working fluids used, as normal hydraulic oils tend to freeze at room temperature under pressures of the order of 30 tons per square inch (4600 atmospheres).

*Behaviour Under Combined Stress.*—The basic curve used to illustrate the plastic behaviour of a material under stress is that of stress against strain in a simple tensile test. This curve represents but one of a number of states of stress and it is not possible to predict the stress-strain characteristic for complex stressing from the simple tensile test. To study the behaviour of materials under these more general conditions it is necessary to be able to apply a controlled combined stress system to the material. Three-dimensional stressing is impracticable but a general two-dimensional stress system can be obtained by subjecting a thin-walled tubular specimen to tension, torsion and internal pressure.

A testing machine on these lines has been five years in development, and is believed to be unique in the world. The loads are applied by three independent hydraulic systems which can be controlled with sufficient accuracy to give the small increments of stress which are necessary when plastic flow has started. Stresses are determined from pressure gauge readings in the case of the tension and internal pressure components, and by mercury or electronic manometers in the case of the torsion component. Strain measurements are made on two extensometers. One of these uses a photographic technique: from the film record the axial and shear strains can be calculated. The other extensometer measures the change in external diameter of the tubular specimen by means of a cylindrical condenser plate around it. The change in capacitance due to the change in specimen diameter can be balanced by an external condenser in a bridge network and the diametral change calculated. All stresses and strains are calculated for the current specimen dimensions, and a complete stress and strain

* Reported in "The Behaviour of Materials under High Hydrostatic Pressure," Parts I and II, by H. Ll. D. Pugh and D. Green, M.E.R.L. Plasticity Reports Nos. 103 and 128.

history can be kept throughout any test programme.

The tests being undertaken have several objectives : (1) To determine which of the theories of plastic stress-strain relations best fits the experimental facts. (2) To find a satisfactory definition of equivalent stress and strain with which to represent plastic stress/strain relations for all types of loading. If this were known it would be possible to predict how a material would behave plastically for any mode of stressing, providing a simple tensile test had been made. (3) To study the effect of prestrain on the yield locus.

The investigation is at present confined to copper, but it is hoped to study the more exotic materials now required for nuclear engineering—for example, beryllium, niobium, vanadium and zirconium. The criteria of failure for brittle materials are also proposed for examination.

*Accelerated Creep of Uranium.*—The accelerated (or "pseudo-") creep rate of α-uranium after neutron irradiation or thermal cycling has been investigated theoretically using conventional plasticity mathematics at the crystal level. Under neutron irradiation, single crystals of α-uranium grow preferentially in one direction, contract in another, and remain unchanged in a third, the total volume remaining constant. In a polycrystalline aggregate this tendency to preferred growth would result in elastic stresses being set up initially and, as irradiation proceeded, more and more grains would be stressed to the yield point, the plastic strains nullifying the growth strains. Eventually, all the grains would be stressed to the yield point. Material in this condition subjected to a stress in one direction, e.g. due to a load or the weight of the α-uranium, has been considered using conventional plasticity theory. The relationship obtained was the same as that given by Cottrell and Roberts,†

$$\dot{\epsilon}_c \simeq \left(\frac{\sigma}{\sigma_y}\right)\dot{\epsilon}_g,$$

where the growth strain-rate $\dot{\epsilon}_c$ due to an applied stress $\sigma$ is given in terms of the growth rate $\dot{\epsilon}_g$ of a single crystal and the yield strength $\sigma_y$.

The same theory could be applied to the deformation of α-uranium under load when subjected to thermal cycling. The threshold at which pseudo-creep occurs (due to internal stresses induced by the anisotropic coefficients of thermal expansion) is determined.

*Cold Extrusion Under Impact.*—It has been suggested that the impact associated with certain presses influences the behaviour of the metal during extrusion. The presses differ from others only in their ram-displacement/time characteristic and ram velocity at contact. These factors affect the rate of strain and temperature rise in the deforming metal. Their influence on the behaviour of metals in the extrusion process has been investigated at M.E.R.L. by carrying out tests in a variable-speed, 150-ton crank-press capable of single-stroke action. The crankshaft, fitted with an eccentric adjustable collar and connecting-rod, gives any required stroke from 3in to 12in. A slide motor gives a 6in variation in daylight and an overload plate is provided. The ram stroke, extrusion load, slug temperature and time are simultaneously recorded on film.

The effects of extrusion ratio, ram speed, lubrication, die geometry, slug length-to-diameter ratio and shape relative to the chamber bore, are being studied using chemical lead, 99·5 per cent pure aluminium, copper, 70/30 brass, titanium, sintered niobium, and various carbon- and low-alloy steels. The implications of increasing the ram speed are not fully understood, and the rise in temperature within the slugs is being studied. With ram contact speeds of 16in per second increases of 20 deg. Cent. have been detected immediately on impact and increases of 250 deg. Cent. have been measured during the final stages of extrusion of aluminium and copper. These temperatures occur at specific points within the slug and are not mean temperatures.

Since products are extensively used in the "as-extruded" condition their mechanical properties are being examined. Preliminary results suggest that, for large reductions, the working of the slug prior to extrusion has relatively little influence on the ultimate hardness. The degree of reduction has a different effect on the hardness of the outer and inner parts of copper and brass products. The surfaces of rods and bores of tubular containers are heavily worked after only small reductions, but there is little change in hardness as the reduction is increased from 19 to 84 per cent. Along the axis of the rod, however, the hardness increases as the reduction increases : the hardness becomes constant along the axis of the product and across its section at a reduction of 75 per cent. The tests are being extended to include high-speed extrusion in a cam plastometer. In this machine the ram-displacement/time characteristic can take any form governed by the cam profile, and ram speeds up to 70in per second are possible.

*Extrusion at Room Temperature and Above.*—Tests have been made with two-aperture dies of various sizes and entry profiles. Lead slugs of 2in diameter and lengths up to 5in have been extruded into rods through different combinations of dies. A study has been made of the incremental flow through such a die arrangement by interrupting the progress of the ram momentarily at intervals throughout the test. The die edge marked a "ring" on each rod, thus giving the incremental length of rod passed through each aperture. Results showed that if the length-diameter ratio of the slug was greater than unity, three phases of flow were present. In the first phase, flow was unbalanced, the metal flowing almost exclusively through the larger aperture. Balanced flow occurred during the second phase, and in the final phase unsteady conditions again developed, the metal flowing faster through the smaller aperture. This work is to be extended to the cold extrusion of tee and angle sections.

The extrusion of 99·5 per cent pure aluminium and an aluminium alloy (DTD 363) at temperatures from 20 deg. to 500 deg. Cent. is the subject of a recent report on experimental work confined to the direct extrusion of 1in diameter slugs through plain sharp-edged dies. Whilst the object was to determine the relevant pressure—extrusion ratio and pressure—temperature relationship, other useful data were obtained for both the pure metal and the alloy. The latter failed due to hot shortness if extrusion was attempted outside certain limits of pressure, speed and temperature. The report emphasises that the scale of operation in an industrial extrusion is appreciably different from that in a laboratory test. Temperature control and uniformity of distribution across the billet is unlikely to be of the same order as in laboratory tests, friction at the container-billet interface is likely to be considerably worse on an industrial scale, and the initial billet structure is different. This indicates a need for quantitative comparison of laboratory-scale data with fully instrumented industrial extrusions.

† A. H. Cottrell and A. C. Roberts, "Creep of α-Uranium During Irradiation with Neutrons," *Phil. Mag.*, 1956, page 711.

## Fatigue of Metals

*Fatigue Testing of Large Components.*—A technique has been devised to enable rotating-bending tests to be simulated without any rotating parts ; it has been developed particularly for fatigue tests on railway axles. The wheel-and-axle assembly is excited in bending at its fundamental resonant frequency by two electromagnetic vibrators displaced mechanically 90 deg. from each other. These vibrators are fed by currents with a 90 deg. relative phase shift, and a rotating-bending force is therefore obtained. A capacitive pick-up in a regenerative loop maintains oscillations at the resonant frequency of the wheel-and-axle assembly. This frequency drops when a crack appears, stopping the test automatically. A more sensitive automatic cut-out monitors the current in the vibrators ; a drop in the amplification factor of the system when a fatigue crack grows lowers the vibrator impedance and causes the current to increase when the vibrator is energised from a constant-voltage source. The frequency of vibrations and axle strains are monitored throughout the test and an electronic counter records the total number of stress reversals to failure.

*Growth of Fatigue Cracks.*—To obtain information on the propagation of fatigue cracks under idealised laboratory conditions, fatigue tests have been carried out on thin panels of various materials. In all cases the panels were about 0·1in thick and were either 9in or 10in wide at the test section. These were tested in either a 6 or a 60-ton Schenck direct-stress fatigue machine, the loading cycles used being such that the specimen was always in tension. Fatigue cracks were initiated from a small central slit of 0·25in to 0·5in overall length. The slits were cut almost to finished size with a fine steel saw blade, the final 0·01in being cut with a thin steel razor blade which had had saw teeth ground in the cutting edge. The extremity of the slit thus formed was about 0·002in wide and 0·001in root radius. The length of the fatigue crack was measured by means of a small hand microscope. All crack lengths and related measurements were measured from the centre-line of the sheet and not from the end of the initial slit. The materials tested included mild steel, aluminium alloy, and copper. With one batch of mild steel, suitably heat-treated, it was found that strain markings were apparent on the surface of the sheet around the tip of the growing crack. Measurements of this plastic zone were made wherever possible. The dimensions of the plastic zone ahead of the growing crack are important in any theoretical analysis of the problem of crack growth. As the length of the crack becomes an appreciable fraction of the width of the sheet the stresses around the tip of the crack will increase even though the load on the sheet is kept constant. It is not easy to apply corrections for the finite width of sheet as the correction involves both the fractional error in the stresses near the crack and also the response of rate of growth to stress. The first of these factors is not accurately known and the second cannot be certainly defined without a knowledge of the basic laws which it is the purpose of the experiment to determine. To avoid any such corrections the analysis has been restricted to crack lengths less than one-eighth of the sheet width.

It has been found that the rate of growth of the crack is proportional to the current crack length,

i.e.

$$dl/dN = kl$$

hence,

$$\ln(l/l_0)=kN.$$

For both mild steel and aluminium alloy the coefficient $k$ was found to be related to the alternating stress according to the equation

$$k=\sigma^3/N_r.$$

For mild steel $N_r$ was independent of mean stress over the range tested, i.e. 2 to 10 tons per square inch, but for the aluminium alloy there was some dependence on mean stress.

The above relations apply to continuous growth. It was found,‡ however, that in some cases crack growth was erratic and dormant periods existed; at the lowest stresses it was possible for non-propagating cracks to form. This leads to difficulties in the formulation of a single law of continuous growth over the entire range of crack length.

## Mechanics of Fluids

*Reversible Turbines for Pumped Storage Schemes.*—The Fluids Division was stated by Dr. D. G. Sopwith, Director of M.E.R.L., to be playing a prominent part in the development of hydraulic machines that would work efficiently both as pumps and as turbines. Such machines are desirable for installation where pumped storage is employed to raise the load factor of a power station.

*Cavitation in Water Turbines.*—Cavitation research on water turbines has followed three main lines: (1) Model-turbine tests have been used to establish cavitation characteristics; (2) The resistance to cavitation erosion of materials suitable for use in hydraulic turbo-machines has been studied; (3) The physical phenomenon of cavitation, the origin, growth and collapse of bubbles, as well as the related mechanism of cavitation damage, have been investigated.

Cavitation tests on scale models have proved indispensable, since the cavitation performance of a design over its operating range can be studied by applying scaling laws, and the observations can be related to design parameters. While such tests can be conducted in an open circuit free to atmosphere up and downstream of the model, a closed, pressure-tight circuit is considered to be more satisfactory. This is because closer control over essential parameters, such as water temperature, and air content is possible, and greater flexibility in operation can be obtained without the limitations inherent in an open system.

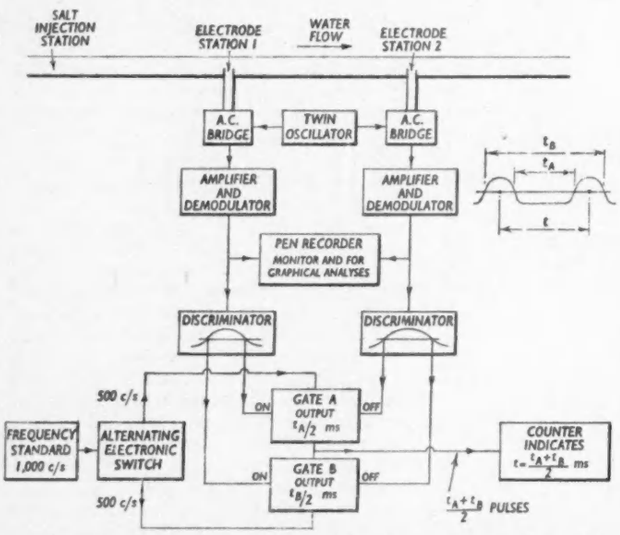
The M.E.R.L. turbine test rig is thought to be one of the most modern of its kind in the world. Designed for flexibility, the tunnel circuit can be quickly modified to accommodate any configuration of Kaplan or Francis model turbine up to 20in runner diameter. Circulation of the water in the tunnel is either by a variable-pitch propeller or a mixed-flow centrifugal pump, with a total of 570 h.p. The speeds of both pumps are automatically controlled. A large vertical reabsorber in the circuit ensures that air which may have come out of solution in the cavitation zone is not recirculated. Pressure control is automatic and the aerating system will maintain the chosen concentration of dissolved air. The rig has a 100 h.p. cooling system to keep temperature constant during tests. All tunnel operations are remotely regulated from the control cabin.

Considerable attention has been paid to accuracy and improved methods of observation. Thus, the vertical-shaft absorption dynamometers, with a maximum capacity of 250 h.p., float in pressurised oil bearings to reduce friction, the torque being balanced by oil pressure and measured automatically. Turbine speed can be measured very accurately by use of a phonic wheel and batch counting. Flow is gauged both by nozzle pressure-differential and current meters permanently installed in the tunnel. Both can be calibrated *in situ* against the main flow-calibration system of the laboratory. Head across the turbine, and ambient tunnel pressures, are determined by fully automatic piston manometers. During tests the turbine runner is continuously observed by means of a closed television circuit.

The model turbines themselves are instrumented for flow investigations. In the Kaplan model, runner thrust and bearing friction can be balanced by oil pressure and weighed. Each individual runner blade can be hydraulically locked in test position. Runner-blade and guide-vane setting is by remote control. The overall performance tests may be supplemented by detailed flow surveys to establish the distribution of losses. Cavitation tests on Francis and Kaplan turbines are supplemented by comprehensive efficiency measurements.

*New Versions of the Pitot Tube.*—New versions of the pitot probe have been developed which offer considerable advantages over the standard, and new techniques have been evolved. Thus, by use of an integration method that has been developed, the number of gauging points (specified by the standards of flow measurement as at least ten per diameter) can be reduced to four or less per diameter. The accuracy of measurement in reasonably symmetric flow is unimpaired; under conditions of distorted flow, a total number of twelve gauging points is suggested, considerably fewer than normally employed in such a case. Again, for measurements in non-uniform flow, a modified pitot cylinder has been developed which, in strongly two-dimensional flow, allows the determination of the magnitude and direction of the velocity at a point by means of a simple calibration curve, from which, in addition, the total and static pressure may be derived. The instrument has been successfully used in field tests.

*Inference of Flow Rate from Dilution.*—One of the basic methods of determining the rate of flow of a fluid across a section is to inject a chemical into the stream sufficiently far upstream to ensure that complete mixing has taken place at the measuring section. If the rate of injection is measured, and the ratio of the concentration of the chemical in solution to that in the dilute sample is analytically determined, the product is the rate of flow of the fluid. No physical measurement of cross-section is required, as with other methods. At M.E.R.L. apparatus has been developed for measuring flow rates up to 350 cubic feet per second. It is anticipated that by the use of improved analytical techniques, this limit may be increased to over 1000 cubic feet per second (500 million gallons per day) without increasing the size of the equipment. In the past, ordinary salt (sodium chloride) in a brine solution has generally been used as the injected chemical. However, as standard practice limits the dilution ratio to about 5000, large quantities of salt are needed and equipment has to be very bulky. In addition, it is normally recommended that injection periods of ten to twenty minutes are necessary to ensure steady conditions. A salt newly investigated in France for measuring the flow in streams and rivers, sodium dichromate, has been used in M.E.R.L. tests. It can be detected at trace levels of less than ten parts per million and a volumetric method of analysis has been adopted which allows for any changes to the salt due to the presence of active reagents in the water. Even smaller traces can be measured by colour absorption methods with a spectrophotometer where, in order to measure the flow rate with an accuracy of 1 per cent, the sensitivity of the method must detect changes of one part of chromium in 300 million parts of water. The method has been tested in the laboratory at flow rates up to 20 cubic feet per second, and in the field up to 75 cubic feet per second, using a long pipeline of 40in diameter. At present, the accuracy of a single test is $\pm 2$ per cent and pipe lengths of the order of 100 diameters are required between the injection point and the sampling point to achieve adequate mixing. Short injection times, of the order of three minutes, are used, requiring only small quantities of chemicals; dilution ratios of up to 20,000 have been measured successfully, using single probes sampling at the pipe centre-line which simplify the problem of installation.




**Improvements have been made to the method of measuring flow rate by timing the passage of salt injections between fixed stations. The diagram indicates how the time is automatically evaluated**

*Inference of Flow Rate from Timed Injections.*—The mean speed of flow can be measured by timing the passage of a quantity of salt solution between two sets of electrodes separated by a known distance. Three improvements in the technique have been made at M.E.R.L. By using an a.c. bridge to detect solution at each electrode, rather than directly measuring change in current, as is usually done, it is possible to employ very small concentrations (one part in a million). This allows small quantities of salt solution to be used and leads to the second improvement, a cartridge-operated valve which injects about 2½ cubic inches of solution in 20 milliseconds. The third

‡ The work is reported more fully in "The Propagation of Fatigue Cracks in Sheet Specimens," by N. E. Frost and D. S. Dugdale, *Journal Mech. Phys. Solids*, 1958, 6 (2).

improvement is a novel method of instant indication of the time between the passage of the centroid of the conductive cloud between the two sets of electrodes.

The improved techniques make field tests simple, and provide results while the tests are under way. In previous methods, it has been necessary to do graphical work after the tests have been completed, and before their success or failure is known.

The demonstration on the open days used a 1in diameter pipe to represent a 3ft diameter pipe, and showed the application of the development version of the field equipment (with the exception of the injection valve). The entire circuits use transistors supplied from batteries, so that no mains supply is needed. The block diagram reproduced on page 924 illustrates the electrical operation.

*Improvements in Current Meters.*—Marked advances are reported in the measurement of flow rate by current meters. (These employ screws whose rate of revolution depends on the fluid current through them.) Standard instruments use chronograph pen recorders: in the M.E.R.L. development these recorders have been replaced by automatic electromagnetic counters controlled by an autotimer with "memory," and the interpretation of chronograph records is cut out. The calibration of meters has been simplified and the methods evolved have reduced the computational effort. An integrating technique has been developed which permits substantial reduction in the number of meters needed, without affecting accuracy, and the method of computation gives results in minutes instead of hours. Field trials have shown current meters to give the most consistent results of all the methods under test, with a scatter of less than $\pm 0 \cdot 3$ per cent from the mean of a test series.

*Pressure Losses in Oil-Hydraulic Fittings.*—Following recommendations made by the industry, a test rig is in use to provide information on the head loss characteristics of fittings of various kinds used in oil-hydraulic circuits. The rig shown in the photograph in last week's issue can provide hydraulic oil at two viscosities and flow rates up to 250 gallons per minute under pressures up to 800 lb per square inch. The temperature of the oil can be held constant to close limits for power inputs up to 150 h.p. Flow controllers and pressure-measuring devices are included to give accuracy to the various measured quantities. The flow into the fittings is smoothed to give uniform conditions.

Results will be plotted in such a way as to make maximum application possible. For instance, if a head loss coefficient is plotted against Reynolds number, it should be possible to show the performance of the fitting for any fluid over the same range of Reynolds number. This means that, although the results have been obtained with oil as the fluid, the same information could be used to predict the head loss characteristics if water were used. If cavitation takes place, this correlation may no longer hold, but when cavitation is absent, the correlation is sufficiently good for most practical applications.

It is hoped that one of the results of this work will be to standardise the form in which such information is presented, at least, for a wide range of the fittings available in Britain. To accomplish this, manufacturers are invited to send a representative, or representatives, with a range of their fittings, to work on the rig under the supervision of the scientific staff of the Laboratory. Such a scheme is thought to have many advantages. It helps the firm to produce vital information on its products at a minimum cost and without capital expenditure. The representatives who do the work will gain an insight into modern research techniques and will be instructed where necessary on the significance of the results, the reason why they are to be plotted in the way suggested, and how such information can be used by their designers. It is also thought that the training thus received by the firm's representatives will be beneficial to the firm in the sense that the men will be more knowledgeable as to research procedure, and more alive to some of the problems raised in their designs as a result of the investigations. It also keeps the research workers more directly in touch with industry and the problems that confront it.

# Large Electricity Supply Systems

No. II—(*Continued from page 884, June 13*)

*The seventeenth full convention of the International Conference on Large Electricity Systems (C.I.G.R.E.) has been held in Paris under the patronage of Monsieur René Coty, the President of the French Republic. The meetings were attended by delegates from forty countries; they began with an opening ceremony on Wednesday, June 4, and the last session was held on June 14. The subjects under discussion were: transformers, teletransmissions, generators, circuit breakers, capacitors, high-voltage cables, system stability and control of load and frequency, insulating oils and materials, insulation co-ordination, reactive and distorting phenomena, protection and relays, voltages over 220kV, lightning and surges, telephone and radio interference. A résumé of some of the papers on generators and of some of the contributions to the discussion is given here.*

To simplify discussion of the papers dealing with generators the subject was divided into two main groups: the first was concerned with the design and construction of the machines; the second covered the operation and testing of the generators. In the first group there were six papers for discussion and their scope is summarised below.

## Direct Cooling of Generator Windings

Design and operating experience with turbo-generators having stator windings cooled by water in direct contact with the copper conductors were described in paper No. 102 by W. N. Kilner (Metropolitan-Vickers Electrical Company, Ltd.). This method of cooling is designed to enable the active material (copper) to be operated at higher specific loadings than would be possible with indirect cooling and is an important factor in keeping the dimensions and weight of the stator within the permissible transport limits.

To prove the practicability of making a direct-water-cooled stator winding and to obtain manufacturing and operating experience a 30MW, 11·8kV two-pole 3000 r.p.m. turbo-generator was built and put into commercial service in 1956. This prototype machine is electrically the same as two other turbo-generators installed in the same power station except that the stator coils are built up with copper tubes, ¼in square, instead of the usual flat copper strip, and contain only 56 per cent of the copper in the conventional winding. Cooling water flows through all the conductors in parallel, passing from a circular manifold at the terminal end, through insulating hoses to each conductor, and, through similar hoses at the other end, to the outlet manifold.* The manifolds are insulated from the frame, to enable insulation resistance of the winding to be measured, but they are earthed externally during operation. The total number of insulating hoses connected to the winding is 192. They are about 18in long with a bore of ⅛in, and with water having a conductivity of 5 reciprocal megohms per cubic centimetre, the total loss of power in the water is 0·7kW. The pumping power at a pressure of 18 lb per square inch is 8·8kW, and the corresponding velocity of the water in the winding tubes is 5ft per second.

The water circuit includes pump, cooler, strainer, flow alarm, water temperature indicator, temperature alarm, and conductivity meter. A standby pump and cooler are also provided.

The water circuit is supplied from a header tank above the machine level, and is actually the turbine gland-sealing tank containing condensate. A small chamber with a float level alarm is provided for detecting any increase in flow above that required to make up for normal pump gland leakage. To remove trapped air from the system when it is filled, a vent pipe is fitted to the top of each water manifold, and connected through a valve to a drain in the basement. Pressure gauges, in each vent pipe, indicate pressure below normal if air is present in the manifolds, or entrained in the water. The water in the winding system is continuously recirculated, and cooled in a separate external water-to-water heat exchanger.

Turbine condensate was used initially to fill the stator winding cooling circuit, and the water conductivity varied considerably, particularly during the first few days of service. The system was drained four times following the initial filling to ensure that it was clean. During operation the conductivity of the water has generally been maintained at values between 5 and 10 reciprocal megohms per cubic centimetre.

The water manifolds, hose end fittings, and pipework between the strainer and the generator are made of stainless steel to prevent oxidisation. The remaining pipework is of mild steel. Light rusting, which occurs when the system is drained and wet, discolours the water, but remains in suspension, and does not affect the conductivity. There has been no sign of electrolysis in the hose assemblies or any part of the system.

During the early stages of operation a few leaks developed in about 2 per cent of the insulating hoses at the points where the metal ends are attached. This defect was found to be due to excessive local bending of the tubes where the material was restrained from normal yielding by the rolled on metal ends.

* The Engineer, June 7, 1957, page 878.

This weakness was avoided when the replacement tubes were fitted.

The leaks developed while the generator was running on full load but did not necessitate shutting the machine down. It was kept running at 60 per cent load, with the water drained from the winding system, until new tubes were fitted. This experience is interesting in that it shows the ability of modern machine insulation to withstand the effects of surface moisture, as no electrical breakdown has occurred.

The choice of material for the hoses is very limited, as they should withstand service conditions for many years, without requiring replacement. The fluorocarbon, polytetrafluoroethylene, in extruded form, appears to meet all requirements, and was therefore used. This material is impervious to water, chemically inert, a good electrical insulator, and withstands high temperature. Tubes of ¼in diameter and approximately 2ft long are sufficiently flexible to withstand vibration, and allow for the necessary adjustments to bring the tube ends into line with the ends of the coils.

The resistance of the column of distilled water within the tube is sufficiently high to keep the power loss in the water to a negligible value, and during preliminary investigations a potential of 100kV was applied across the ends of a column of flowing water, 2ft long, drawn from the Manchester public supply, without any effect other than raising the water temperature by the estimated amount.

In the generator, the voltages across the water columns increase successively round the phase bands, to a maximum of phase voltages on the line terminal conductors. The total loss of power in the water at 40 deg. Cent., for the whole generator, as stated previously, is only 0·7kW with a water conductivity of 5kW or 7kW with a conductivity of 50. Water conductivity is therefore not critical, a desirable feature, because in a newly installed plant, the boiler condensate may have a conductivity of about 40, which is reduced to 1 or 2 after a few days' running.

The temperature rise of the water flowing through the windings is only about 2 deg. Cent. In the case of the prototype winding which has a relatively low specific loading, it would have been permissible to arrange for the water to flow through a number of coils in series, but the object in making this generator was to obtain manufacturing and operating experience which could be applied to much larger generators.

In the larger generators, greater advantage will be taken of the cooling properties of the water by further reducing the copper section of the coils, and the temperature rise of the water will therefore be greater. In the case of the 200MW generator now under construction the temperature rise of the water will be about 8 deg. Cent. This is still a low temperature, but it is considered desirable that it should be so, as it provides a good margin to allow for temporary failure or reduction in the water supply due to the stoppage of the pump or restriction of the filter.

During the works' tests on the prototype generator, with full load current in the stator windings, the raw water to the water-to-water cooler was shut off for ten minutes, and the rate of temperature rise of the winding water was only 1·5 deg. Cent. per minute. A further test was made with full load current in the winding, and the winding water pump stopped for five minutes, without any dangerous rise in temperature of the water or windings.

Standard works' tests were carried out, including a temperature run at approximately full rated load of 37·5MVA, 11·8kV zero power factor, a three-phase sudden short-circuit test at full voltage, and a final high-potential test of 24·6kV for one minute between phases and to ground. During all these tests water was flowing through the stator conductors.

A comparison of the temperatures of the water-cooled generator and one of the conventionally-cooled generators in the same station, both operating at full load 0·96 p.f. is tabulated here.

*Comparative Temperatures of Water-Cooled and Conventionally Cooled Generators*

| | No. 3 set (water-cooled) (deg. Cent.) | No. 1 set (conventionally-cooled) (deg. Cent.) |
|---|---|---|
| Stator copper ... ... | 30 | 80 |
| Between coils in slot ... | 43 | 70 |
| Core teeth ... ... ... | 50 | 64 |
| Core ... ... ... | 58 | 64 |
| Inlet air ... ... ... | 21 | 26 |
| Cooling water ... ... | 16·5 (to water-water cooler and air coolers) | 16·5 (to air coolers) |

The 200MW, 16·5kV generators now being made have water-cooled stator windings and connections generally similar to the prototype machine except for the parallel strands, which are made from rectangular tubes which are wider and not so deep as the square tubes employed in the first winding. This is necessary in order to minimise eddy currents, as the complete conductors are larger and carry a heavier main current. The prototype generator is air-ventilated, but the casings of the 200MW generator will contain hydrogen at 30 lb per square inch pressure. The water circuit will be maintained at a pressure below that of the surrounding hydrogen. The water pipes which must pass through the hydrogen-tight casing are brought out through insulation bushings, similar to those used normally for the main terminals of hydrogen-cooled generators. This is to enable normal routine measurement of the stator winding insulation resistance to ground. The main generator terminals are also water cooled, which results in their being very much smaller, and more easily accommodated than the normal conventionally-cooled type. The water in the stator winding circuit will be cooled in heat exchangers, employing boiler feed water as the coolant, so enabling some of the heat losses of the winding to be recovered.

Substantial reduction in the dimensions and weights of turbo-generators can be made by using this form of cooling, which is now being used for 200MW, 16·5kV generators under construction, and will permit still larger generators to be constructed at manufacturers works, without the weight and dimensions of the largest single piece exceeding the transport limits of Great Britain.

The broader design aspects of direct cooling, whether by gas or by liquid, were among the topics studied by F. Müller and E. Wiedemann (Brown Boveri) in paper No. 106 which dealt with possibilities in the design and use of large, single-shaft turbo-generators. According to the authors a new increase in the specific output of the rotor can be obtained with the usual gas pressure of 2 kg per square centimetre in relatively narrow channels, and with small copper losses, by means of a compressor which is independent of the alternator. Such an arrangement is being used on a generating set of 240MVA now being built and will be a prototype for outputs up to 500MVA. The independent compressor and cooler is designed to enable the rotor temperature to be controlled at a constant value over varying conditions, independently of the excitation. With direct cooling of the rotor and stator windings the size of large generators is no longer limited according to Müller and Wiedemann, by thermal considerations but only by the efficiency, on the ground that single machines of, say, 250MVA to 500MVA can only be justified if the total losses do not exceed those of two smaller machines (which could be cross-compounded, for example). A high ratio of rotor length/diameter is required and a value of 6·5 is quoted in respect of generators now under construction in Europe.

The possibilities and advantages of turbo-alternators with forced cooling were examined in paper No. 147 by M. Dureault (Matériel Electrique S.W.), P. Letrilliant (A.C.E. de Jeumont), and A. Valentin (Alsthom). These possibilities can be summarised in the concept that any increase in generation power factor will provide a reserve of rotor excitation; to take advantage of this reserve a corresponding increase in stator ampere turns should be sought.

## Asynchronous Running of Turbo-Generators

In a paper (No. 118) on the asynchronous operation of turbo-generators, G. Darriens (Compagnie Electro-Mécanique) discussed the advantages of an asynchronous rotor having a distributed polyphase winding instead of the usual two-pole rotor winding. In an asynchronous machine of the kind envisaged by the author the rotor body is like that of an orthodox machine except that it has the additional slots to accommodate a polyphase rotor winding. The excitation for this winding is supplied through sliprings by a polyphase commutator machine such as a Scherbius machine. A very small and adjustable slip (between 0·0001 and 0·00001) can be maintained and an appreciable improvement in cooling conditions achieved.

Other aspects of the asynchronous running of turbo-generators were dealt with in paper No. 115 by P. Ch. Kovács and F. Csáki, of the University of Technical Sciences of Budapest. The tests described in this paper were carried out on turbo-generators running asynchronously, with two main objects. On the theoretical side it was hoped to add to existing knowledge of certain transient characteristics, including damping of large machines with heavy rotors. On the practical side it was hoped that, if the test results were favourable, they would determine the conditions under which a set could continue to run as an asynchronous generator if the excitation failed, and could continue to supply the network with active power. Under such conditions asynchronous running, even for a comparatively short time, would facilitate a changeover to standby excitation or, alternatively, the sharing of the load between other alternators on the busbars.

Tests were carried out on three turbo-generators the main particulars of which are as follows:

No. 1 set: an old design, 44MVA, 10·6kV, star-connected winding, 2400A, three-phase, 50 c/s, 3000 r.p.m., power factor 0·7. Rotor resistance 0·069 ohm, the winding being in parallel slots, with steel slot wedges. Synchronous reactance in direct axis of alternator $x_d = 1·9$ (relative units). Exciter, 140V, 1200A, 3000 r.p.m.; pilot exciter, 140V, 11A, 3000 r.p.m. De-excitation resistance 0·64 ohm (1000A) and 110 ohms (1A).

No. 2 set: a new design, 26·5MVA, 10·5kV, star-connected winding, 1460A, three-phase, 50 c/s, 3000 r.p.m., power factor 0·75. Rotor resistance 0·082 ohm, a cross lap winding in parallel slots with bronze slot wedges. Synchronous reactance

in direct axis of alternator, $x_d$=2·2 (relative units). Exciter, 140V, 1000A, 3000 r.p.m.; pilot exciter, 165V, 5A, 3000 r.p.m. De-excitation resistance, 0·3 ohm (600A) and 30 ohms (3A).

No. 3 set: the characteristics were similar to those of set No. 2 except that the rotor slot wedges were of steel instead of bronze.

The conclusions drawn from the results of the tests are that (because the slip is small) the rotor losses during asynchronous running are a small fraction of the excitation losses that occur during synchronous running, and are negligible. The limiting output of the generators is determined by the stator current and not by the slip. If the average current in the stator is not much more than the nominal value, machine No. 1 can be loaded up to half its nominal active power and machines Nos. 2 and 3 up to three-quarters. By using the de-excitation resistance the active output can be slightly higher than when the rotor is short-circuited. Asynchronous running is, therefore, practicable in the case of the three machines studied and the authors of the paper conclude that similar performance can be expected generally from turbo-generators of European manufacture. The reactive power that must be supplied by the network while a machine is running asynchronously does not exceed that provided by the machine when it is running synchronously.

### Insulation

Research towards improving the resistance to ageing of the stator insulation in large turbo-generators was described in paper No. 129, by K. Abegg, Ch. Caflisch and F. Knapp (Oerlikon, Zurich). In this paper the service behaviour of asphalt- and shellac-bonded mica insulation was examined with particular reference to ageing, caused by chemical action, the presence of volatile elements in the insulation, fatigue resulting from vibration, creep, and dielectric fatigue, including the thermal effects of dielectric loss and the action of corona on solid insulation. Recent research upon methods of improving resistance to ageing is summarised. The epoxy resins offer many advantages as bonding agents that will ensure the stability of micafolium. Among the materials whose properties are studied in the paper are "Samicafolium," "Orlitsa" and "Emorlite" insulation using synthetic-resin-impregnated "Samicafolium" tape.

For insulating stator bars in large generators the following method may prove to be technically and economically superior. The straight portion of the bar is insulated with hard and resilient "Emorlite" (consisting of reconstituted mica with glass-fibre support), the coil ends being insulated with asphalt impregnated "micanised" tape resistant to compression. The plasticity of the coil ends required for assembly is thus preserved and the slots have a high quality insulation. The end joints of the micafolium sleeves, known in the past for their tendency to open up, are now much improved by the use of epoxy "Samicafolium." The "Emorlite" adheres so well to the copper that there is no longer any fear of the joints parting. This mixed insulation thus gives the cumulative advantages of bar sleeves and continuous tape insulation.

"Emorlite" is at present undergoing a very extensive test programme. The early results so far available are satisfactory.

Long duration tests at 12kV, with temperatures of up to 160 deg. Cent. applied to test bars insulated with "Emorlite," have so far produced good results. After having raised the thermal strain during several days up to 210 deg. Cent. without an applied voltage and subsequently reverting to 20 deg. Cent. for a measurement of the loss angle as a function of voltage, no deterioration was found in the insulation qualities. According to the authors micanised epoxy metallo-organic resin insulation offers the smallest losses in the whole temperature range of 20 deg. to 200 deg. Cent.; less than 2 per cent up to 100 deg. Cent. and less than 6 per cent up to 160 deg. Cent. Ageing tests in hand promise a stability suitable for class-F insulation.

In the second part of a report presented by the generator study committee (No. 17), G. Belfils, A. Wust, and L. Carpentier gave the results of work done on d.c. testing of dielectrics for stator windings. Tests were carried out by the Laboratoire Central des Industries Electriques at the request and with the collaboration of Electricité de France. The tests were mostly on the determination of the correlation co-efficient (d.c. breakdown voltage)/(r.m.s. a.c. breakdown voltage) under certain test conditions, on scrapped windings from worn out machines as well as on new samples. Windings from ten generators taken out of service for re-winding, with a life of more than ten years, were tested to destruction. Some associated questions, such as the stress distribution in a winding and the influence of rate of voltage increase, were briefly investigated.

Examination of recent results seems to show, in agreement with various opinions based on theoretical considerations, that there is no universal co-efficient. The result obtained depends on the nature of the insulation (pure mica, laminated insulations), on its amount of wear and on the kind of fault likely to occur (breakdown by a puncture of the mica, or by creep or by thermal breakdown), and on the method of testing. The value to be adopted for the correlation co-efficient may therefore depend on the use for which it is required (routine control checks in d.c. on separate sections, acceptance tests on new winding, verification tests on worn machines) and perhaps also on the nature of the insulation. Research to be undertaken in the near future in the various countries should be co-ordinated by a unified working programme laying down the value of the important parameters in order to ensure the possibility of comparing results.

### Discussion

The papers on generators were discussed on June 6 under the chairmanship of Mr. G. Belfils, with Mr. A. Wust as special reporter.

Mr. L. W. James (Central Electricity Generating Board, Great Britain) referred to recent changes in the design parameters of turbo-generators for steam power stations to meet the need for increased reactive power on the expanding grid system. Not many years ago generators for central stations were designed for power factors of 0·8 and short-circuit ratio of 0·9; but, for the 275kV system, a greater stability margin was required and the corresponding values envisaged for the new machines were 0·9 and 0·75. To meet the anticipated reactive power requirements machines ordered two or three years ago, however, had corresponding design values of 0·85 and 0·6 respectively. But, within the last six or nine months tests on automatic voltage regulators embodying magnetic amplifiers had indicated that 60MW sets could run stably at a 130 deg. rotor angle implying that a value of s.c.r.=0·3 would be satisfactory. For larger machines than those recently ordered this reduced value would give a new lease of life to existing techniques applied to a system with a rapidly growing reactive power demand.

H. Weissheimer (Siemens-Schuckertwerke, Germany) gave some results of calculations made by his company of direct cooling by hydrogen and by water. For a 500MW machine the efficiency obtained with hydrogen was about 0·1 per cent lower than with liquid cooling. Outputs of 400MVA to 500MVA at 50 c/s could be obtained without difficulty, using hydrogen cooling, with a rotor of 1·5m diameter (illustrated by a slide) but a higher output could be obtained from the same system, by having a liquid-cooled stator. He considered that for outputs of the order of 320MVA the choice between hydrogen and liquid cooling was marginal.

W. A. Kilner (Metropolitan-Vickers, Great Britain) touched on the economics of direct water cooling for stator windings and amplified the information given in his paper (No. 102). He affirmed that the extra costs including those of the auxiliary equipment were not large items. For example, in the case of the 30MW turbo-generator already installed, the extra cost of the tubular conductors was between £2000 and £3000. The pumps and water cooler were conventional and inexpensive items and the extra cost of the auxiliary instruments was of the order of £200. Because of transport difficulties it might become necessary in the future to use cold-rolled grain-oriented steel on machines of very large outputs. In that event liquid cooling would show to advantage, since on a 200MW generator, for example, the difference in the depth of stator slot, as between a water-cooled and gas-cooled design, would result in a saving of 20 tons in core weight. Such a saving would be a substantial item if grain-oriented steel were involved.

J. H. W. Morgan (English Electric, Great Britain) discussed direct cooling and questioned the figure, given by Kilner, of 20 tons to be saved in the core weight by using water cooling instead of gas cooling. He went on to refer to the 150MVA, 3000 r.p.m., turbo-generator designed and being built by his company; the stator is direct-cooled by hydrogen circulated by a gear-driven axial flow compressor. Because radial ventilation of the rotor might cause temperature differences across the slot axial cooling is used by circulating the gas along the hollow conductors (two conductors in parallel per slot). The rotor diameter of 35in is about the same as that of a conventional 30MVA machine. Similarly, the rotor of a direct-gas-cooled 200MVA machine would have the same diameter as the rotor of a 100MVA machine with conventional cooling and the difference in length between bearings would be only about 1in.

V. Easton (G.E.C., Great Britain) also spoke about methods of direct cooling and illustrated his remarks with a slide depicting the slot arrangement to be adopted for a water-cooled stator winding. The water enters the winding via six inlet points at one end of the stator and leaves at six exit points at the other end. He claimed that the arrangement he described was compatible with considerable simplification of insulation methods particularly as applied to the end windings and terminals. In a 200MW turbo-generator built with a water-cooled stator of this kind the copper loss would be less than 0·2 per cent.

B. M. Cain (General Electric, U.S.A.) pointed out that the designer of very large turbo-generators now had a choice of various systems of cooling. Whilst he agreed with much in the design philosophy propounded

in Morgan's contribution to the discussion he (Cain) believed that, for the machine sizes now contemplated in the U.S.A., water cooling offered advantages in many cases. In his country rotor cooling had not yet become a limiting factor in the design of large sets. He considered that 500MVA was easily possible with present methods of construction; outputs of 750MVA were contemplated within the next ten or twelve years.

L. W. James (Central Electricity Generating Board, Great Britain) was one of the speakers who gave an account of tests on the asynchronous operation of turbo-generators. He said that in asynchronous tests made, shortly after the second world war, on a 30MW turbo-generator with a solid rotor an output of 12MW was obtained for two hours before temperatures approached a safe limit. One possibility of practical interest was that of running the machine as a solid rotor set for, say, five minutes in an emergency such as excitation failure.

F. H. Birch (Central Electricity Generating Board, Great Britain) dealt with the same topic and described some British experimental work in this field. Tests had been carried out on a 60MW, 0·8 p.f., 3000 r.p.m., hydrogen-cooled turbo-generator with a direct-axis synchronous reactance of 200 per cent and fitted with non-magnetic end bells. This machine was tested in conjunction with a 72MW transformer having on-load tap-changing gear. The set was adjusted to give 100 per cent of rated power, the tapping being chosen to produce 0·8 power factor lagging at the rated voltage. With the machine running the field circuit breaker was opened, the rotor circuit being closed on a discharge resistance, whereupon the terminal voltage fell to 64 per cent of its previous value. The slip increased to 2 per cent and the stator current to 225 per cent of full load current and it was estimated that the limiting stator temperature would have been reached after about five minutes.

On reclosing the field circuit breaker the generator did not synchronise itself and it slipped poles until a further reduction had been made in the turbine output. Accordingly it was concluded that the turbine torque should be reduced by about 50 per cent before restoring the field.

*(To be continued)*

# Aircraft Ice Protection

*At Luton Airport on Wednesday, June 11, D. Napier and Son, Ltd., held a conference on aircraft ice protection. Five papers were read and discussed, including one on the "Development of Ice Protection Control Systems," by Mr. E. O. Robertson, of Canadian Applied Research, Ltd., read in his absence by Mr. D. L. A. Hand. For details of electrical heater mats and the technique of de-icing, the reader is referred to our account of Napier "Spraymat" on page 420, March 19, 1954; we reproduce below parts of Mr. Robertson's paper.*

THE present trend in aircraft design suggests that the popularity of electro-thermal de-icing is on the upgrade. Both the Bristol "Britannia" and the Convair "880" have hot gas anti-icing for main planes and have adopted electrothermal de-icing for the empennage, due to the high weight penalty of a hot gas duct, from the propulsion units to the tail, which must be stressed for the duct/cabin air pressure differential and thermally insulated for cabin comfort. If this trend is already established to-day, it seems most likely that future aircraft, having propulsion units grouped around the tail, e.g. the de Havilland "DH121," the Bristol "200," the Vickers "VC10" and the Sud Aviation "Caravelle," to name a few, will have the problem of ducting vast quantities of hot gas from the tail forward for main plane ice protection unless designers resort to electro-thermal de-icing.

Finally, as cruising speeds and stalling speeds increase, more thought is being devoted to high lift devices to permit operation of high performance aircraft from limited runways, and these devices, often, can only be protected against icing by an electro-thermal de-icing system.

## Icing Detection

To initiate icing protection when necessary and to discontinue such protection when icing is ended, a form of ice detector is necessary. It is true that a pilot's vision could be described as a first-class ice detector, with some assistance at night from a lamp; however, a pilot's vision is limited in its scope and may well be fully occupied, along with the rest of him, as an automatic pilot, an approach and landing aid or even as an airline public relations officer, in the cabin with passengers, and therefore his suitability as an icing detector must be questioned. Finally, in modern jet aircraft it is usually impossible to see into the engine intake where icing may readily occur, in climb conditions, where the intake velocity ratio is greater than unity, even in clear air at temperatures above 32 deg. Fah., when no ice is accreted on the airframe for the pilot to see.

Since ice accretion occurs when super-cooled cloud droplets impinge on a body moving through them, an ice detector can operate on two basic principles, namely:

(*a*) The detection of free water at temperatures below 32 deg. Fah., or

(*b*) The detection of a finite quantity of ice on a portion of the unit.

Both methods have merited a great deal of development, and the latter has been more widely adopted for two reasons:

(*a*) There are many ways of obtaining a usable signal from a small accretion of ice, and

(*b*) The basic value of an ice detector is to provide warning that ice is actually accreting or about to accrete on an aircraft rather than a warning that free water in some form, be it liquid, ice crystals, hail or snow, is present in the ambient atmosphere.

The detection of the presence of free water in the air has been achieved by subjecting two heated elements to an airflow in such a manner that one is exposed to direct impingement by water droplets whilst the other is shielded from such impingement by careful design of the airflow into the detector to ensure, as nearly as possible, 100 per cent momentum separation of the droplets from the air before it strikes the shielded element. Such an arrangement, assuming that the velocities over the two elements can be maintained equal, result in equal convective heat losses from both elements, but high evaporative and heat to water losses only on the exposed element, and by simply measuring the temperature differential of the two elements, the presence of free water can be readily detected; this intelligence, coupled with the knowledge that the ambient air temperature is below 32 deg. Fah., gives warning of icing.

Although such a detector has some advantages, it also has disadvantages. Various other types of detector have been devised, some of which had moving parts in the air-stream. Bearing in mind the various applications of an ice detector, and the problems of maintaining reliable operation, the company with which I am associated decided to adopt the orifice pressure-operated principle, for practical development.

This principle was the subject of early development work at the Royal Aircraft Establishment, Farnborough, which led to the production in the U.K. of ice detectors operating by this method. Later, the National Research Council of Canada, reviewing the various means available for ice detection, further developed this principle from the stage at which the R.A.E. left it, and all these developments, including additional improvements described below, were incorporated into the final production ice detector by my company.

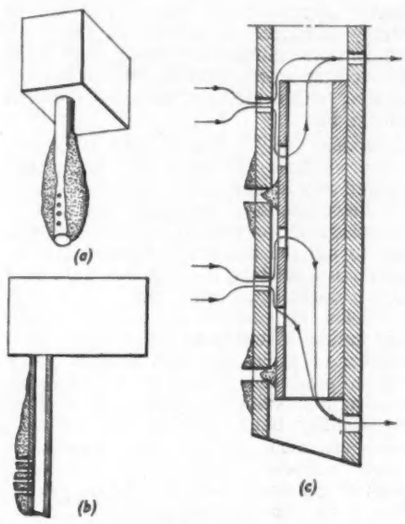
Three types of orifice/pressure differential operated ice detectors are known to be in production to-day, one in England and two in North America. Though they vary in detailed design, they operate on the same principle, and only one will be described in detail.

All units have basically a cylindrical probe which is exposed to free stream conditions, this probe having a number of ice sensing holes near the tip and similar pressure sensing holes in the rear face. Air pressure from this probe is transmitted to a pressure sensitive switch which derives a reference pressure, against which detector probe pressure is balanced in the switch, from some alternative source, either a reference pressure probe, aircraft static pressure or from the detector probe rear holes. In ice-free conditions the detector probe realises a pressure at the switch which is a function of the total $q$ or dynamic pressure. When icing conditions are encountered, accretion at stagnation on the probe will result in blockage of the forward facing holes and hence a pressure change at the switch. This pressure change will initiate an icing signal and switch on a heater in the detector probe, which consequently sheds the accreted ice, thereby restoring normal or ice-free pressure conditions at the switch; this in turn may be used to switch off both the icing signal and the detector probe heater.

The particular detector which is described below comprised, in its initial form, two units, namely, an ice detector probe having four forward facing holes and two rearward holes and incorporating a 200W, 28V heater which was connected pneumatically and electrically to a pressure switch and relay assembly. Reference pressure for the switch was taken from the aircraft static line. The detector probe also incorporated a small "U"-shaped guard so located as to shroud the rear holes. This guard was found essential to prevent a melted ice accretion being blown from the stagnation line and sliding around the probe and refreezing over the rear holes, the ice being very thin and held in place, in spite of the air velocity, by

surface tension ; with a guard, it was found that ice sliding around the probe would strike the guard and be carried away by the slip stream.

Early tests proved that this form of ice detector was satisfactory up to a point ; the temperature range over which it would detect was limited (Fig. 1 (*a*). In a low heat loss icing condition, which would result only in lateral ice accretions on small bodies, such as the probe, no ice would form at stagnation to block the ice sensing holes. Also, at high heat loss conditions (Fig. 1 (*b*)),




(*a*) Lateral ice formation on detector probe.
(*b*) Rime ice formation in detector probe.
(*c*) Detector probe with baffle.

**Fig. 1—Probe ice formation**

when a true rime formation occurs, it was noted that the ice formation over the leading edge of the probe included four neat holes right through the ice at the ice sensing holes, and again no blockage occurred. This limitation was not considered serious where airframe icing was concerned, but these conditions could prove very serious in the intakes of gas turbine engines, particularly where screens are fitted. For this reason, a small baffle was developed (Fig. 1 (*c*)), and subsequently patented by the National Research Council of Canada, which was installed inside the detector probe and behind the ice sensing holes. With such a baffle, the airflow through the detector probe had to follow a "dog's leg" path, which resulted in considerable momentum separation of water droplets, which, in turn, produced an ice accretion on the baffle which built forward to block the ice sensing holes. In this manner, the detector probe became sensitive to icing over virtually the entire temperature range.

One installation of this type of detector, in a long intake duct for a gas turbine engine, was found to give considerable trouble and a full scale investigation was undertaken by the aircraft constructor. As a result of this investigation, it was established that a pressure gradient exceeding 3in of water pressure existed, at certain flight and engine conditions, in the intake duct static pressure between the duct skin and a point 3in from it. Since the reference pressure for the pressure switch was derived from a flush static orifice at the same duct section as the detector, and since the operating pressure of the pressure switch was only 3in of water, these findings indicated clearly the need for improvement. A probe was therefore developed as a third unit in the same system, for use as necessary, to provide a suitable reference pressure. This probe was identical in all details to the detector probe except that it was continuously heated and had four holes in the rear face and two of the forward holes were slightly enlarged ; this probe produced a reference pressure equal to static plus approximately 10 per cent "$q$," or dynamic pressure.

During the time that these developments were being made, aircraft speeds were rapidly increasing, which led to further developments in this ice detection system with a view to improved performance, decreased weight and the ability to operate in the most adverse environmental conditions.

Higher speeds resulted in rapidly rising ram pressures, and the stage was fast approaching at which the sensitive pressure switch would become deranged by the pressures involved, and it was therefore decided to modify the ice sensing holes to produce more suitable recovery factors in the detector and reference probes. As originally designed, the detector probe pressure of approximately $P+0{\cdot}5q$ (where $P$=static pressure and $q$=dynamic pressure), was fed to the inside of the switch capsule and the reference pressure, approximately $P+0{\cdot}10q$, to the housing around the switch capsule, resulting in a pressure differential expanding the capsule of about $0{\cdot}4q$ in ice-free condition. When the detector probe became iced, the open rear holes produced a negative pressure in the switch capsule equal to $P-0{\cdot}8q$, with a resultant differential pressure of 0·9 collapsing the capsule and causing the switch to operate ; the switch was adjusted to operate when this collapsing pressure equalled 3in of water, which roughly corresponded to 71 knots airspeed at sea level.

The switch capsule was so designed that no damage could be sustained with very high collapsing pressures, but expanding pressures in excess of 12 lb per square inch, or 333in of water, were found to affect the 3in of water pressure switch setting. Since the U.S. military specification for ice detectors requires that the unit shall be tested at 200 per cent of the pressure realised at 550 knots for 500 cycles, and another North American specification called for even higher test pressures, it was found necessary to modify the probe recovery factors to limit the expanding pressure differential at high speeds. A relationship was established between probe recovery factor and the area ratio front to rear holes, and, to simplify manufacture, a final configuration was reached in which both probes have identical rearward holes and the forward holes are identical in diameter, the reference probe having four and the detector probe five. This gave pressure recovery factors of 0·4 and 0·6 for reference and detector probes respectively, with a differential pressure of $0{\cdot}2q$ expanding the switch capsule in the ice-free condition, and $1{\cdot}2q$ collapsing the switch capsule in the iced condition. This final configuration resulted in increase of maximum speed to which the unit could be exposed without damage and also in a decrease in the minimum speed to produce a signal.

Finally, to reduce weight and installation costs, the three individual units of the original system were incorporated into one single package ; as soon as this was done, access to probe heater connections was lost, and it was necessary to introduce electrical circuits to control the reference probe temperature to prevent overheating. Furthermore, to permit ground testing in very low heat loss conditions, a similar temperature control circuit was considered necessary in the detector probe, though never required to operate in flight. These controls were originally achieved by the use of thermistors to control the heater relay coil voltages, and have subsequently been improved with the advent of new electronic components by the introduction of transistor amplification of the out-of-balance signal from a Wheatstone bridge network in which the variable arm comprises a thermistor.

Since the pressure capsule, to be sensitive to small pressure changes realised at low flight velocities, cannot produce large contact forces at the switch contacts, and is liable to operate slowly, resulting in slow make and break at the contacts, the detector circuit is so arranged that the control relay which issues the icing signal and switches on the detector probe heater requires a minimum power for operation and carries holding contacts in parallel with the pressure switch

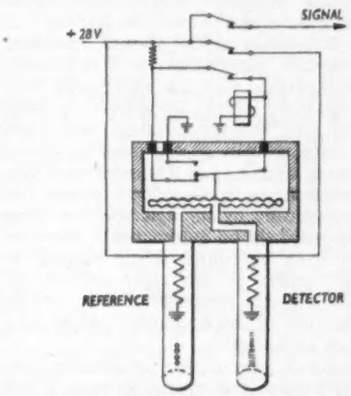



**Fig. 2—Circuit diagram of detector in iced conditions**

(Fig. 2) ; in this manner, the pressure switch forward contacts will operate the control relay, which is self-holding when the pressure switch contacts break, and when ice is shed and normal ice-free pressures are restored, the pressure switch back contacts are remade to short circuit the relay coil, through a limiting resistor, releasing the relay and breaking its holding contacts. It is evident, therefore, that the pressure switch loads are held to a low level, relay chatter is eliminated and, finally, the pressure switch is required only to make circuits and never to break them.

The decision to adopt a pressure switch setting of 3in of water to signal was dictated to some extent by manufacturing difficulties, but a minimum speed for signal, which depends on this setting for any given probe pressure recovery factors, had also to be considered ; 62 knots at sea level, which corresponds with this pressure setting, was deemed satisfactory minimum speed for the majority of present-day aircraft. Regarding the $\frac{1}{2}$in of water pressure setting for switching off the signal and detector probe heating, this figure was chosen to ensure that no signal could persist where air speed is very rapidly reduced, which is another way of saying that no arming circuit is required which can result in false signalling in, for example, an engine intake duct during run-up for checking prior to take-off.

Finally, it is apparent that there is no air mass flow through the switch and capsule area of this ice detector, which eliminates all risks of water, ice or duct collection in this area which could jeopardise its performance, nor are there any exposed moving parts which could become inoperative as a result of icing.

Regarding development on the electrical

side, this has been aimed at improved reliability with reduced size and weight. It has been achieved by the introduction of modern electronic devices, such as transistors and thermistors, which have only become available comparatively recently, since the initial development was undertaken.

Being basically simple, the maintenance of the unit is virtually reduced to keeping the probes clean, and periodic checks that the pressure switch is in tolerance ; these latter checks require no complex test apparatus or great skill to perform as the unit is self-protecting against abuse on ground test.

Certain special features have been added, by special requirements, for some non-standard units ; a small manually-operated switch can be added to raise temporarily the control temperature of the reference probe from about 50 deg. to 100 deg. Fah. plus, so permitting checking of the reference probe heater and control circuits on the ground at ambient temperatures above 50 deg. Fah. without artificial cooling. A second interesting special feature, requested by an aircraft constructor, is a time delay unit incorporated with the ice detector as a single package, which will ensure an icing signal of sixty seconds' duration, which will rezero automatically as the detector proper issues icing signals ; in this manner, engine ice protection, for instance, can be switched on automatically by the detector/time delay package and held on automatically throughout an icing encounter severe enough to produce signals at less than sixty-second intervals, and then switched off sixty seconds after the end of the encounter without any action by the air crew.

Two basic types of this ice detector have been developed, one operating from a 28V d.c. supply and the other from 115V, 400 cycles a.c., though they are otherwise interchangeable ; from these basic types, variants, with baffled or unbaffled probes and special features incorporated, have been developed. The 28V d.c. unit has been successfully subjected to the American military qualification tests specified in U.S. MIL-D-8181, which is the equivalent of the Ministry of Supply type test schedule, and it is planned to complete similar tests this year on the 115V a.c. version. These tests include endurance of 25,000 signals, vibration to 10*g*, high (+167 deg. Fah.) and low (−65 deg. Fah.) temperature, humidity, shock, temperature shock, fungus resistance, salt spray, dielectric strength to 1000V r.m.s., &c.

This detector weighs about 1½ lb and its electrical load is about 350W intermittent, a favourable comparison with the floodlight often used to-day for inspection of the main planes at night for ice accretion.

### De-Icer Controllers

It is well known that an electrothermal de-icing system for fixed wing aircraft requires a narrow anti-iced area or parting strip at stagnation, operating in conjunction with intermittently heated or shedding areas located behind stagnation and separated by anti-iced dividing strips. With the advent of swept wings and the partial disappearance of a stagnation line, there is some difference of opinion regarding the value of the anti-iced areas, but this is not truly relevant to the subject of controls.

It has been conclusively shown, by the National Research Council of Canada, both in icing wind tunnels and in extensive flight tests with the Rockcliffe " Ice Wagon," that :

(*a*) Parting strips should be held to a minimum width without risk of bridging.

(*b*) There is an optimum ice build-up for clean, efficient shedding, and

(*c*) There is an optimum time during which shedding areas should be heated.

Obviously, a parting strip which is too cold will permit ice bridging and render the whole system ineffective, and therefore it must always maintain the wing surface at stagnation, over the full travel of stagnation, above 32 deg. Fah. It is also established, if less obvious, that too wide a parting strip will reduce very seriously the aerodynamic shedding forces available to ensure clean effective ice shedding. Therefore, to achieve these requirements, it is essential to control the surface temperature of the parting strip, since any one fixed power dissipation density cannot result in an optimum parting strip width in all conditions of heat loss to be expected in operation. Finally, it is obviously necessary to switch on parting strips as soon as possible on entry into icing conditions before any appreciable accretion exists at stagnation which will prove difficult to melt through if heating is delayed. If an accretion ice detector is used on the airframe, some finite accretion must exist on the flying surfaces before the detector operates and there is some further time delay before the heater pads can raise the surface temperature to 32 deg. Fah. In these circumstances, it may be necessary to raise the control temperature of the parting strips for a fixed time, after entry into icing conditions, to ensure complete anti-icing while the system " warms up."

Regarding optimum ice build for good shedding, it is evident that if shedding is delayed too long, ice will build forward and eventually bridge a parting strip, which is itself maintained above 32 deg. Fah., leaving a layer of air or water between the heated stagnation area and the ice itself. Also, if shedding is attempted too soon, when the ice build up is ¼in or less, it has been shown that the shedding is patchy and incomplete, the ice often sliding back till it refreezes on the unheated area or breaking up into small areas, which, in turn, slide back and refreeze ; this is equally true of the upper surfaces where negative aerodynamic pressures exist as of the lower surfaces where these pressures are positive.

Finally, a certain minimum energy must be dissipated in heat at a shedding area surface to melt the ice interface and free the accreted ice from the surface, anything less than which will result in incomplete shedding. If, however, excessive heat energy is dissipated at this surface, the result is a running wet anti-iced surface which produces run back ice formation in the area behind the shedding area. This will be of minor importance in a short encounter, but if icing conditions prevail for any protracted time, this run back formation can reach proportions where this ice itself constitutes a catchment area and, hence, can grow very rapidly and dangerously, seriously increasing drag and, depending on its chordwise position, reduce lift also ; this ice, it should be remembered, forms behind a shedding area and can never be shed, unless a secondary shedding area is provided, until the ambient temperature rises above 32 deg. Fah.

*Parting Strip Control.*—Parting strip control, being extremely simple, is one of the least penalties paid for proper de-icing control. The normal practice is to incorporate a temperature sensing element in the heater pad as close to the outside surface as possible. This temperature sensing element usually takes the form of a thin wafer-like resistance element, similar to a strain gauge, wound with a wire, such as nickel, which has a high temperature resistance coefficient ; its signal is fed into a Wheatstone bridge network whose unbalance can be used to modulate power to the parting strips. Where an initial heat is required at the parting strips, it is simple to shunt the temperature sensing element with a fixed resistor, effectively decreasing the resistance of this arm of the bridge, for a limited time. When this time has elapsed, a simple time delay relay can be used to open circuit the shunting resistor. It is very true that accurate temperature measurement at a wing surface is extremely difficult to achieve cheaply and reliably, but it must be stressed here that accuracy is not too important ; control to ±5 deg. Fah. of the temperature at the sensing element is usually adequate, and the control can be simply calibrated to correct for the small temperature differential which may exist between the sensing element and the external surface, which, anyhow, should not exceed 10 deg. Fah.

*Shedding " Off " Time Control.*—The control of shedding off time is less simple than parting strip temperature control, in that it is a direct function of the rate of ice accretion. To achieve this control, it has been the practice to use the repeatable sensitivity of an orifice ice detector to feed this parameter into a controller ; when this is done, the controller must count ice detector signals and initiate a shedding cycle when a preset number of signals has been received. It is hard to predict the precise number of signals to correspond with an optimum ice accretion for shedding, but it is not difficult to build a controller which can be simply modified to initiate a shedding cycle after any number of detector signals between, say, two and twenty. Where this feature is incorporated in the controller, it is only necessary to calibrate one trial installation to achieve correct settings for all similar airframes. This procedure was adopted on the CF100 " Canuck " all-weather, twin-jet fighter designed and built by Avro Aircraft, Ltd., and the resultant signal count was set to fifteen detector pulses.

When the preset number of pulses has been received by the controller, it must start a shedding cycle and restart the detector signal count at zero. Should the accretion rate be great enough to " saturate " the system and produce the preset number of detector signals whilst a shedding cycle is in progress, a memory circuit must operate which will discontinue the detector signal count and start a second or subsequent shedding cycle as soon as the first is completed, and at this instant recommence the detector signal count. If, however, the accretion rate is too slow to " saturate " the system, the controller must discontinue shedding at the end of a cycle until the preset number of detector signals has been received from the start of the last shedding cycle.

*Shedding " On " Time Control.*—The ideal control of shedding time for each area is one which affects switch off as soon as ice shedding occurs, i.e. switch off must be a function of heater pad surface temperature It is reasonable to assume that the controller incorporates a stepping switch or rotary selector switch which transfers power in sequence through the shedding areas ; if, therefore, this switch carries an additional pole or distributor board, this can be used to switch shedding heater pad temperature sensors in turn into one bridge circuit, similar to that used for parting strip temperature control, and the out of balance signal from this bridge can be used to operate the shedding area selector, at the same time selecting the corresponding temperature sensor. Such a control must, of necessity, add some complexity to the shedding area heater pads by the incorporation of temperature

sensors, but this form of control, like the parting strips, requires no great accuracy and can be calibrated in the same manner.

Obviously, some time limit is necessary for shedding time duration, and a control must be provided to switch shedding areas when this time has elapsed, even if the switching temperature at the surface has not been reached. This is achieved by a simple timer, set, for example, to fifteen seconds, which will cause shedding area switching to occur after this time has elapsed, if the temperature sensor has not already demanded switching.

An alternative, though far less effective, shedding "on" time control is similar to that described above, but utilises a single temperature sensor, sensing some temperature between ambient and total, which controls the time lapse of the timer effecting cyclic switching. It may be argued that, since this will tie in shedding on time with temperature, it is as good as using individual sensors and far simpler, but this is not so. A single sensor can take no account of heater pad voltage, which may well vary $\pm 8$ per cent, i.e. $\pm 15$ per cent on a power basis, and this variation is wide enough to render the single sensor control too insensitive to shedding area surface conditions to be really effective.

*Protection Switch-Off.*—Finally, there is the need to switch off de-icing when it is no longer required. Switch off should not occur either part way through a shedding cycle or prior to a shedding cycle when an ice accretion exists on the flying surfaces which is inadequate to initiate a shedding cycle. This controlled switch off can be achieved by the use of an "overhang" timer, where "overhang" time is defined as the time elapsed between ending an icing encounter and commencing to switch off protection. This timer should time out in anything between two and four minutes and should reset to zero each time an ice detector signal is received, thereby ensuring that overhang time does not commence until the end of an icing encounter. When the overhang time has elapsed, the controller should immediately initiate a shedding cycle to clean off any ice accreted since the previous cycle ended, and then switch off everything, rezeroing all counters and timers in so doing.

*Weight and Life.*—Aircraft constructors must be anxious to know what will be the weight penalty for such a controller and what life expectancy it should have. No single or firm answer can be given to this question, but the weight of a simple controller performing the functions above might lie between 5 lb and 15 lb, according to the size of, and power density of, the shedding areas. Regarding life, ice detection equipment should be good for 25,000 signals and a controller should be good for 2500 shedding cycles without maintenance; assuming eighteen shedding areas with an average on time of ten seconds each, this amounts to 125 hours' operation; if icing occurs 5 per cent of the aircraft's flying hours, such a controller would be good for 2500 flying hours.

*Environment.*—It is worth while here to mention the effect that specified environment has on the equipment discussed. Both in North America and England, standard environmental specifications exist, which are too often quoted verbatim in particular equipment specifications, with resultant unnecessary weight and cost penalties in the equipment designed to meet the specification; for instance, an ice detector may be required to operate over the temperature range $-65$ deg. to $+248$ deg. Fah. when icing cannot occur beyond the temperature range $-40$ deg. to $+32$ deg. Fah., and it is reasonable to assume that any single package ice detector will all be at a temperature within the range of $-50$ deg. to $+60$ deg. Fah. at any time that it is required to operate, except perhaps for ground test, where the temperature may be up to 120 deg. Fah. A more realistic requirement would, therefore, be an exposure temperature range of $-65$ deg. to $+248$ deg. Fah. without damage and $-50$ deg. to $+120$ deg. Fah. for satisfactory operation. Often, too, altitudes up to 60,000ft plus, and sustained accelerations up to 9*g* plus are specified for civil transports, which appear excessive requirements in the circumstances.

### Discussion

This paper gave rise to animated discussion; in an earlier address, Mr. W. Sherlaw had observed that the experience of Rolls-Royce, Ltd., was that detectors were either able to indicate ice immediately or function reliably, but not both. Since the capability to overcome a delay in switching on the heater was expensive, a detector that would turn on the system within seconds of encountering icing conditions was urgently needed. Mr. L. R. Stephenson (Bristol Aeroplane Company) considered that a complex control system for the de-icing equipment could not be justified, although he agreed that if the heater "on" time was not monitored, secondary de-icing surfaces behind the primary mats were necessary.

Mr. I. Hay (Vickers-Armstrongs, Ltd.) suggested that if the primary surfaces ran adequately far aft, ice formation behind them was slight. If secondary panels were fitted, they could be switched on by the pilot as required. While the saving in energy dissipation offered by automatic control would only be small in terms of fuel weight, the saving in installed weight would be significant; the penalty was exacted in reliability.

Mr. Hand pointed out that automatic heater control should allow smaller primary mats.

Mr. Stephenson responded that on the "Britannia" a mat of 6 per cent chord was none too large when flying through large droplets. Run-back of water was due to lack of control over the heaters, not to inadequately long mats.

## British Welding Research Association

The British Welding Research Association held its open day at the Abingdon Hall research station on Wednesday, June 11, when a very large number of members and guests were given an opportunity to inspect the laboratories and see some of the work in progress. One of the principal speakers at the open day luncheon was Sir Claude D. Gibb, who said that industrial firms should give a greater measure of support to the Association. He pointed out that in an establishment of this kind the vital spark of enthusiasm could only be kept alive if, in addition to pure research, it also carried out fundamental research based upon future industrial needs. In this connection, committees performed an important role in giving inspiration, but they should not in any way impede the men engaged in actual research.

Mr. A. R. Jenkins, the chairman of the Association's council, pointed out to the visitors that the progress of work on some of the long-term projects was not easy to see from year to year. Results of this work, however, were important and would be reflected in industry in years to come. At the moment the staff of the station was up to its full strength and the facilities provided by the projected new building for welding work would do much to improve conditions for operators.

Amongst the work at present in progress in the fatigue laboratory of the establishment is a study of the fatigue properties of mild steel shafts reclaimed by welding. In this connection it is considered that the influence of stress concentrations may not enter the problem of avoiding significant reductions of the fatigue strength of shafts reclaimed by surface welding. It is stated to appear, therefore, that the principal cause of strength reduction will have to be found in the metallurgical aspects of surface reclamation; thus, actual strength may possibly be related to the welding procedure used. In the present work on this problem, 2in diameter mild steel shafts are being tested under circumferential bending, with a reclaimed portion of the surface in the area of maximum stress. The effect of preheating and post-heating is of major interest at the present time, but to establish a basis for comparison, tests on "as-welded" specimens are being conducted and some of the initial results were shown.

Amongst the equipment shown in operation there was a machine specially developed for examining the fatigue behaviour of thick-walled pipe containing circumferential butt welds under conditions of internal pulsating pressure. This machine, designed by the Mechanical Engineering Department of the University of Bristol, attains maximum pressures of up to 20 tons per square inch, with operating frequencies up to 800 cycles per minute. Another machine has been installed for the testing of large welded shafts in alternating torsion. In it there is used a simple, freely suspended, two-mass system which is excited into torsional vibration by a mechanical oscillator. When a shaft is connected to the end masses the resulting system has a natural frequency in alternating torsion of about 2000 cycles per minute. This equipment was shown in operation with a specimen shaft 8½ft long and 6¾in outside and 3in inside diameter. In a similar resonance testing equipment for torsion testing specimens up to 1¼in diameter one end of the specimen is fixed and the other connected to a mechanical exciter which forms the end mass.

In the welding laboratory a joint research with the E.R.A. is being carried out into arc characteristics of the self-adjusting arc. In it the relationship between arc voltage and welding current has been determined for a series of specified wire feed speeds. These volt-ampere curves all exhibit a characteristic shape, which can be related to the mode of transfer of the metal from the welding wire to the weld pool. At low arc voltage there is almost continuous short circuiting of the arc; as the voltage is increased (without altering the wire feed speed) the current rises, and there is a zone in which short circuiting occurs only occasionally. With further increase of voltage, short circuiting of the arc ceases and the current becomes substantially independent of the voltage. The relation between these characteristic curves and the penetration obtained in the weld bead has been determined. With increasing voltage, the penetration increases to a maximum value, which occurs at the transition from the second to the third of the three zones mentioned above—thereafter the penetration decreases slightly with increasing voltage.

When high currents are used in inert gas metal-arc welding of aluminium, limitations have been experienced as a result of "puckering" due to turbulence in the weld pool, and further work has been carried out on the special nozzles developed by the Association to give an increased gas coverage which removes this limitation. With the latest nozzles welds are being made in aluminium plate up to 2½in thick, and investigations are now in progress on the design of suitable edge preparations and methods of controlling the weld pool.

Problems encountered in weld cracking and low joint strengths when welding high-strength "Duralumin" type alloys have been overcome in the laboratory by the use of a filler wire containing 7 per cent copper, 3 per cent silicon, and 0·8 per cent magnesium. Some typical test results on welds made with this filler wire were shown, and the advantages of being able to use the high-strength alloy in welded structures illustrated by two portal frames, one in alloy HE30WP, which has been loaded to the collapse point, and one in alloy HE15WP, which is carrying the same load without failure.

# LETTERS AND LITERATURE

## Letters to the Editor

*( We do not hold ourselves responsible for the opinions of our correspondents )*

### PUBLIC CITY TRANSPORT

SIR,—In your issue of June 6, 1958, you condemn the suggestion of a ban on the private car from central London as being " unacceptable to the public," and " counter to the whole trend of development." Has the majority of the public (non-car owning !) therefore to be left to struggle in the anarchy of unregulated private traffic ? If the " whole trend of development " is, as it most certainly is, towards stagnation, is it not folly to encourage it ?

CHARLES B. PENNINGTON

Derby,
June 11, 1958.

### RAILWAYS INTO ROADWAYS

SIR,—As a young railwayman, I have been reading, with a natural bias, the very interesting discussion upon the proposal of Brigadier Lloyd to turn the railway system into a road system.

One point that does not seem to have been mentioned is the number of staff employed to maintain, respectively, in good condition, the railways and the roads. The roads are maintained by the highway authorities in part from the rates and in part from a Government grant, and the maintenance is thus financed as a levy upon the nation, whereas the railways are maintained by their own staff and the maintenance is financed only by the user as a part of the fare, or charge, paid at the commencement of the journey. Could it be estimated how many men would be required to maintain the " super road from railway " compared to those men maintaining the railways to-day ? Would maintenance be only done at night, and would it involve the equivalent of single line working ? If the answer to the first is " Yes," then an organisation similar to that of the London Underground would be necessary ; if the answer is " No," then the reply to the second must be " Yes," and a bottleneck be created immediately.

Another point that does not seem to have been considered is the mesmerising effect of driving at high speed between the close walls of tunnels, or the parapets of viaducts. In both cases the width is usually not more than about 27ft to 28ft. One cannot expect to drive as close to a vertical wall as one would drive to a kerb, so that 4ft to 5ft must be deducted for " clearance," which then gives an effective lane width of 11ft. I submit that this lane width is too narrow to allow for even a slight mesmerisation of the driver as there is insufficient space for a centre kerb (of doubtful efficiency). I am well aware of the equivalent railway danger of " sleeper flicker " from which I have suffered myself whilst travelling in Swiss and Austrian railcars.

Then there is the problem of the single track tunnel. Taking the worst example that I am aware of, the Patchway New Tunnel, 1 mile long and 16ft 6in wide between walls. Would you, sir, be prepared to drive a heavy lorry under these conditions at 60 m.p.h. ? Another equally trying example would be the 150 yards tunnel nearing Farnborough on the main line from Waterloo. Here the railway uses four single track bores in a cutting about 65ft wide at track level. The formation width would be excellent for a road, but the idea of driving straight at a 15ft wide tunnel would appal me.

Finally, how soon could a tunnel be cleared in the event of an accident, without having equipment at each tunnel ?

J. L. LEAN

London, W.5,
June 10, 1958.

SIR,—In your issue of June 13 it was refreshing to be reminded by Mr. J. R. M. Thomas that most of your correspondents on this subject do have at least one thing in common, which is a bitter dissatisfaction with the present state of transport affairs. Even those that might go all the way with him, and despair of things being " intelligently used " in Britain, would hardly oppose an inquiry ; for any improvement will be worth while : the aim must be to get ahead of other countries, not necessarily to achieve perfection—which only spells procrastination. An early inquiry was, in effect, recommended as long ago as 1955 by O.E.E.C. in their report on Traffic Engineering and Control in the U.S.A. Why do we maintain these expensive international organisations, and finance their pilgrimages, only to ignore their findings ? Mr. Thomas has ample cause to despair.

Then Mr. D. L. Turner neatly compressed in one short letter all the longings of railwaymen for their railways to acquire the characteristics of railways converted into motor roads without the pains of conversion. He ended by embellishing the picture of the railway of the future that has materialised in the course of this correspondence. But the five additional, expensive refinements he introduced are already commonplace in road transport, viz., a high rate of deceleration, automatic traffic lights, switching the vehicle to right or left by the driver himself, self-propulsion of each vehicle, bodies in the form of containers. Indeed, as soon as any thoughtful railwayman starts on the details it becomes very clear that road transport is his model, his rival. And this despite the fact that road transport—in its present form as purely highway transport—is but a poor thing ; converted railway transport would outrival it, and the combination of the two in Britain would far outrival the transport system of any other country in the world.

In the realm of argument that was perhaps too quick a transition from the finer details to the world scene, but the great difficulty in this matter always has been to get away from the details—especially among engineers: in particular, principles have been elusive. A principle derives from a factor so strong that there can be no compromise over it ; it is therefore a rarity. Nevertheless, I would maintain that, over the past few decades, developments and events have established the employment of small, free-running vehicles as the basic principle in transport. In head-on conflict with it there stands the much-quoted dogma of the British Transport Commission on " the great natural advantages of railways as bulk transporters." But what are the advantages of bulk transportation ? The financial position of the railways, their declining proportion of the nation's traffic, and the swelling volume of road traffic all seem to indicate that bulk transportation is merely a primitive form of mechanical transport from which the public, including industry, are turning with ever-increasing readiness. Meanwhile, blind acceptance of the principle of bulk transportation is not only leading to inconsistency in argument, but is also costing the country about £66,000,000 per annum in railway deficits plus some £145 million per annum on railway modernisation—say, £4,000,000 a week, which must be very galling to residents along the 180 miles of the ill-fated Midland and Great Northern Joint line who are soon to be left with no service at all in return for their contribution towards that weekly addition to the national debt.

T. I. LLOYD

Railway Conversion League, Ltd.,
123/124, Newgate Street,
London, E.C.1,
June 15, 1958.

SIR,—With the possibility of helicopters and other revolutionary forms of transport becoming more and more important in the future, and bearing in mind the very great amount of capital invested in railways, it would seem doubtful whether roadways can ever be proved to have the over-riding advantages which would justify such a major change as their conversion from railways. A less ambitious scheme, although it would admittedly entail very considerable expenditure, would be the provision of motorways constructed above railways so as to permit rapid road transport from the centre of large towns into the country. Such motorways would provide arteries for fast-moving road traffic without the very great expense of purchasing the property which would be on the line of a new conventional motorway.

A motorway such as is proposed would be particularly valuable on the south side of London. For example, one might be constructed from the vicinity of Victoria Station, perhaps to the south side of Croydon, where it would be connected to the Brighton Road. In connection with such a scheme, multiple-floored garages could be provided near Victoria Station which would prevent the motorway adding to the congestion of Central London. If Croydon Airport were to be converted to a Heliport, such a motorway would provide an excellent link with Central London.

It is, of course, admitted that there are a number of problems in carrying out such a

scheme, such as those associated with the crossing of over-bridges, but it is submitted that these could all be overcome and that with modern methods of construction (such as by exploiting prestressed concrete to the full) economic solutions could be found to these problems. Surely an investigation on these lines would be more worth-while than that of " Railways into Roadways."

D. P. BERTLIN

Westminster, S.W.1,
June 16, 1958.

SIR,—In his response to my letter of May 3, Brigadier Lloyd, by a very careful manipulation of his statistics, has endeavoured to show that, even with commuter services, the conversion theory can still stand up to careful investigation. For the sake of clarity, I would like to deal with his statistics under three main headings—(*a*) track occupation, (*b*) vehicles and timings, (*c*) economic employment of labour. Again we will take the Great Eastern suburban electric services from Liverpool Street as a typical example.

(*a*) *Track Occupation.*—Having accepted the fact that 60 m.p.h. running between stops would be necessary for public road vehicles to maintain railway timings, Brigadier Lloyd states that the capacity of a single traffic lane is up to forty-eight vehicles per minute, and there would thus be ample room for private motorists to join the public vehicle flow in their own cars. Nowhere, however, has a traffic flow of forty-eight vehicles per minute, at an average speed of 60 m.p.h. and over distances of 20 miles, been achieved in a single traffic lane, and I refuse to accept that even with all possible rules, regulations and exhortations to drivers, this flow could be achieved. It is one thing to say that under certain circumstances forty-eight vehicles can pass a given point in a minute, and that in other circumstances an average vehicle speed of 60 m.p.h. can be attained. But it is a totally different thing to marry these two sets of circumstances together.

Whilst on track occupation, Brigadier Lloyd claims that the Liverpool Street–Shenfield line, in common with other lines from London, is sufficiently wide near London to allow for several traffic lanes. May I remind him that all the statistics dealt with in this particular aspect of the argument relate to commuter services only and that the extra lanes would not be available for suburban services for the same reason that they are not, by and large, available now, namely, because the additional traffic lanes would be required for the longer distance services, in this case London to Ipswich, Harwich, Clacton, Norwich and Yarmouth, &c. We are dealing in this correspondence with the contemplated movement of 20,000 commuters per hour by road vehicles to suburban destinations, and, generally speaking, there would only be one traffic lane available in each direction for this type of traveller.

In conclusion, I note that Brigadier Lloyd has not touched on the difficulties of vehicles getting into and out of this hypothetical traffic flow at intermediate points without causing disruption.

(*b*) *Vehicles and Timings.*—If we take a deep breath, we can swallow Brigadier Lloyd's contemplated sixty-seater, single-deck bus, 50ft long, although I would mention in passing that such a vehicle, in the traffic flow envisaged, would need to be capable of braking from 60 m.p.h. to a standstill in twice its own length—a very dubious prospect indeed. But to arrive at his requirement of 166 such vehicles for the Liverpool Street services, Brigadier Lloyd has assumed the average run to be only to Romford (12 miles). In fact, 84 per cent of the services proceed beyond this point and the average run is very nearly 20 miles. Thus, at one blow, his estimated bus requirements are stepped up from 166 to around 270, and all Brigadier Lloyd's statistics must be increased *pro rata*, i.e. by about two-thirds.

(*c*) *Economic Employment of Labour.*—I am sure that Brigadier Lloyd had his tongue in his cheek when he submitted his comparisons of passenger miles weekly, and arrived at a figure of 21,600 passenger miles weekly for his own scheme as against 2400 for London Transport. His figures are not analogous for two very sound reasons. First, his own figures are passenger miles per driver and London Transport's are passenger miles per employee, from which we must presume that Brigadier Lloyd will not require maintenance men, garage staff, inspectors, conductors and the like. Secondly, he has assumed the same drivers under his scheme to be lifting both the morning and the evening peak traffics. This is not possible in an eight-hour day, and the days of split duties are very nearly a thing of the past. After making allowance for these and other discrepancies, his margin over London Transport fades to nothing.

*Conclusions.*—The idea of linking units or vehicles to form a " train, " to lift passengers quickly and in bulk, has stood the test of time and cannot possibly be improved upon by de-linking the train into individual units with individual drivers with variable temperaments, travelling at variable speed to variable intermediate points of call, as is envisaged under the conversion theory. It is impracticable and uneconomical, and despite the ancient British tradition of raising a daily groan in the popular Press, the London commuter services are, by and large, models of their kind and are highly efficient at the job in hand, namely, that of transporting huge numbers of people quickly and cheaply.

I make no apology for repeating what I consider to be one of the most important aspects of this issue, namely, the carnage caused by road transport. The prospect of Brigadier Lloyd's sixty-seater, 50ft long, single deckers, travelling at 60 m.p.h. and at anything up to forty-eight vehicles per minute in a single traffic lane, intermingled with private cars at variable speeds, and with departures and entries into the traffic flow at many intermediate points, will surely only solve the London traffic problem by killing off the overflow in its first few months of operation.

The conversion theory must inevitably founder on the jagged rock of the commuter services, and as this involves track occupation around every major city, the whole theory, to my mind, collapses with it.

E. R. SMITH

Dagenham,
June 11, 1958.

SIR,—In recent weeks there has been the inevitable flow of letters for and against the conversion of the railways to motorways. Many have been knee-deep in emotion, some have looked soberly at the concept, but I must admit I feel that most of the opinions expressed have been rather short-sighted. Let us suppose that we convert our railways to motorways wherever practicable, and let us consider the effect on the country as a whole. It would be 80 per cent dependent for all its transport upon oils and petrols, products which we do not possess naturally and which have to be imported. Britain would be absolutely at the mercy of whoever controlled the vast oilfields of the Middle East and America. From the direction of recent political moves, Russia is well aware of our present dependence upon Middle East oil and she is spreading her spider's web over these oily flies. Remember Suez and then consider how bad the situation would have been had we had virtually no railways. On this point alone I would consider conversion as totally unacceptable at the present time.

Now let us look to the future. Natural fuels like oil and coal will run out in 200 years or so. So it seems that the internal combustion engine will gradually die out as the prime land transport power unit. However, I think it is very likely that vehicles thirty years hence will be powered by an electric motor using, probably, cells that derive current from the formation of water from hydrogen and oxygen—the opposite of hydrolysis. With this form of clean, relatively silent vehicle, conversion might well be an acceptable proposition. So, at the present time, I would say to the promoters of this concept, find something better to do, you would only give control of Britain's transport to a foreign and not necessarily a friendly power.

ALAN SAUNDERS

Winsford, Cheshire,
June 11, 1958.

## Books Received

*I.P.C.S. Handbook*, 1958. The Institution of Professional Civil Servants, Queen Anne's Chambers, 28, Broadway, London, S.W.1. Price 8s. 6d.

*Conformal Transformations in Electrical Engineering.* By W. J. Gibbs. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 45s.

*Applied Mathematics for Engineers and Scientists.* By C. G. Lambe. The English Universities Press, Ltd., 102, Newgate Street, London, E.C.1. Price 42s.

*Theory of Structural Analysis and Design.* By J. Michalos. The Ronald Press Company, 15 East 26th, New York 10, N.Y., U.S.A. Price 12 dollars.

*The Directory of Opportunities for School Leavers*, 1958. Edited by Clive Labovitch. Commarket Press, Ltd., 1, Lower James Street, London, W.1. Price 8s. 6d.

*Electrical Engineering Practice.* Vol. I. Sixth edition. By J. W. Meares and R. E. Neale. Chapman and Hall, Ltd., 37, Essex Street, Strand, London, W.C.2. Price 60s.

*Analytical Mechanics for Engineers.* Fifth edition. By F. B. Seely, Newton E. Ensign and P. G. Jones. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 58s.

*Causes and Prevention of Corrosion in Aircraft.* By T. C. E. Tringham. Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 25s.

*A History of Technology. Vol. IV: The Industrial Revolution.* Edited by C. Singer, E. J. Holmyard, A. R. Hall and T. I. Williams. Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 168s.

## Book Reviews

**Spannbetonbau. Vol. 2.** By WOLFGANG HERBERG. B. G. Teubner Verlagsgesellschaft, Leipzig. Price DM.26

IN this second volume, Dr. Herberg describes in detail a large number of bridges and structures built in prestressed concrete. It is essentially a case book of construction and prestressing methods, the theory and properties of materials having been dealt with in his first volume. It is particularly valuable for its descriptions of bridges, since it covers the whole field from the first, the Oelde bridge, built in 1938, up to those constructed in 1956. It is difficult to find in this book any major prestressed concrete bridge which is not referred to. The essential information about them is set out in tabular form and excellent drawings illustrate the details of construction.

The many and various methods of prestressing and make-up of cables are described in detail. It is the first time that the reviewer has seen such a comprehensive list. In Germany in particular a large number of methods are available and they will all be found here ; since it is so comprehensive it is surprising to find that the Gifford-Udall-CCL and the PSC system are not mentioned.

Other structures are also described, although the lists of them are not nearly so comprehensive, and in building structures in particular some very well-known structures have been ignored and others included which have no particular merit. A few pages are devoted to tanks, pipes and roads, but in a very incomplete way.

This book is to be recommended to anyone who is particularly interested in bridge construction. Since it is so excellently illustrated this book will be extremely useful to the engineer without a thorough knowledge of German. The only regret is that it is not so useful for other types of structures and for this reason may give a biased view of the usefulness of prestressed concrete as applied to all forms of construction.

**The Economics of Industrial Management** By WALTER RAUTENSTRAUCH and RAYMOND VILLERS. The Mayflower Publishing Company, Ltd., 41–45, Neal Street, London, W.C.2. Price 60s.

THIS book is specially intended for managers of industry and for students in industrial organisation and economics, and bearing this in mind the rudiments of the subject have not been neglected. The book is divided into three parts : the first visualising the business as a whole, followed by a consideration of industrial cost characteristics, while the third part is devoted to the business as part of the " national plant." The fundamentals of the accounting process are described, and the various financial statements necessary with their interpretation are explained, while the value of keeping a profit and loss chart, a break-even chart, and a sales mixture chart is stressed, and the character and usefulness of each of these charts is clearly explained.

The necessity for having a thorough investigation of all the relevant factors before financing a business is discussed, and comparisons made between two or more companies as to earnings, the effect of plant design on the economic characteristic of a business being considered, while the advantage of merging two businesses and the problems involved are clearly set out. The authors claim that " the break-even chart of a company is useful to management because it establishes the characteristic or standards of all classes of expenses in relation to output and sales " ; certainly a correct and detailed knowledge of all expenses, both constant and variable is essential, and this introduces us into the realm of the cost accountant, whose functions are briefly explained, and the method of splitting up prime cost into material, labour and factory expense is explored. We are left rather in doubt as to the best method of recovering factory expense, or oncost, that is to be applied to a product. We should like to know whether the authors favour the machine-hour rate method, and if so how they would apply it in periods of depression. The necessity for an efficient estimating department might well have been stressed, and the value of regular statements comparing estimated and actual expenditure being prepared might with advantage be pointed out, indeed for efficient results to be obtained estimating and cost accounting must be in the closest liaison. We notice that no allusion is made to the necessity of the cost account being interlocked with the financial account.

A chapter is devoted to the important subject of unit costs, and it is indicated that the determination of the cost of operating a process, and of performing a unit operation becomes of great importance when alternate equipment and methods of manufacture are under review. We are told that " the ultimate goal of management from an economic point of view is to maximise the profit of the enterprise. The goal cannot be reached by merely following a well-established routine." We are in full agreement with this, and suggest that there are British industries that might take note of this statement, indeed it is well that it has been thought desirable to devote a chapter to the relative worth of alternatives. The choice is rarely between a good and bad solution, but rather to ascertain what is best. Replacement of machinery is a good case in point, and when to substitute an expensive machine for one which seems to be doing its job is always a problem, indeed such considerations lead us into a discussion of automation, and the possibilities offered by the use of electronic computers, and the application of mathematical methods. A useful investigation into the economic life span of machinery is made, but it is suggested that at the present time " the matter is still in the development stage and is even a controversial subject."

Part III of this book deals with a subject which certainly has not received much attention from British engineers : " the business as part of the national plant." Here the authors have not in mind such ideas as nationalisation but rather co-ordination of effort. A step towards national integration may perhaps be found in trade associations, but the authors visualise going much further than this. It is asserted that the business-man's yardstick is the dollar, for this book is written from the American standpoint. This yardstick, however, is a variable one which complicates the problem while credit inflation, combined with monetary inflation still further complicates the issue. The question for the business-man is how can the effective demand be evaluated and forecast, and to be able to be successful it is claimed he must study the condition of population, and also the purchasing power of that population, for we are told that " an accurate forecast of the customer's intentions and financial possibilities means the difference between failure and success in business." A chapter is devoted to the probabilities of future production with a view to the determination of whether or no an expansion of the business is justified, an eye being kept all the time on the state of competition and its possible increase.

All phases of industrial management have been covered in this book, some in considerable detail, others more sketchily, and in their conclusion the authors affirm that " throughout the book a special effort has been made to show how scientific methods of analysis and measurement can be used to help solve the problem of decision making to the extent that the decision is directed by economic considerations " and in this we feel they have been successful. We fully agree with their final conclusion that " the methods described will never provide a substitute for managerial ability. It is the manager's responsibility to make the decisions. Scientific methods of measurement and analysis do not eliminate the taking of certain elements of risk," but in the hands of a capable and progressive manager what is available for him in this book should prove of considerable help in arriving at rational decisions.

This work concludes with a number of problems, questions being set on each chapter in turn, the answers not being given, but the reader who has grasped the contents of the chapter concerned will be able to supply satisfactory answers.

**The Finite Twisting and Bending of Heated Elastic Lifting Surfaces.** By RAYMOND L. BISPLINGHOFF. Mitteilungen aus dem Institut für Flugzeugstatik und Leichtbau an der Eidgenössischen Technischen Hochschule Zürich, No. 4. Verlag Leemann, Arbenzstrasse 20. Postfach, Zürich 34. Price : S.Fr.14.

AN experimental as well as theoretical investigation is described of the finite twisting and bending of heated elastic lifting surfaces of long rectangular shape. Special attention is paid to the character of the chordwise deformations and the role played by them in coupling the bending and twisting actions. Temperature gradients are assumed to occur over the surface and throughout the thickness (modified Marguerre theory), producing thermal stresses and affecting the modulus of elasticity. The theory is applied to two limiting cases, viz., a longitudinally stiffened cambered plate with varying stiffness along chordwise lines, and a cylindrical shell with cambered longitudinally stiffened cover plates and without internal structure. Finally, there is presented a brief discussion of linearised shallow shell theory in the presence of temperature gradients with an application to small vibrations of heated elastic lifting surfaces. A total of six model tests was carried out under conditions of thermal equilibrium.

**Elektrizitätszähler.** BY WILHELM BEETZ. Verfahrens- und Messkunde der Naturwissenschaft, Heft 9, Friedr. Vieweg and Sohn, (20b) Braunschweig, Burgplatz 1, Brunswick. Price DM.8.80.

IN Booklet 9 of the series " Verfahrens-und Messkunde der Naturwissenschaft," Dr. Beetz surveys the design and development of electricity meters and time switches. The treatise, which was first published ten years ago, summarises the most important aspects of those electricity meters and time switches which at present are in current general use. References to the literature are given for the benefit of those who wish to acquaint themselves with the finer details of the subject. The publication of a third edition has served to revise the book and bring it up to the newest state of the art, as well as bringing the bibliography up to date.

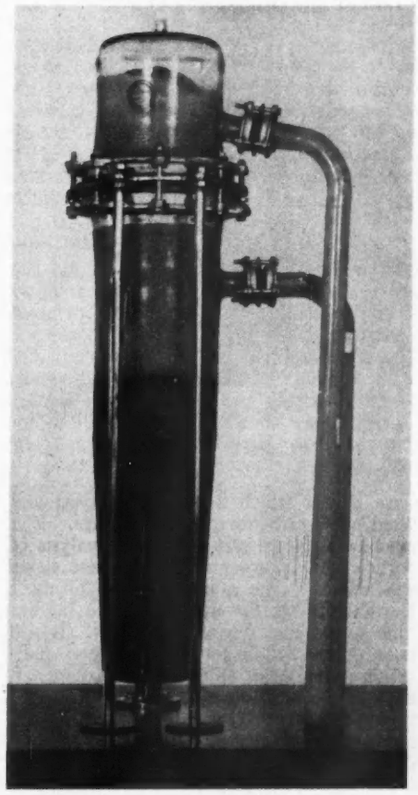
# Chemical and Petroleum Exhibition

No. I

THE Chemical and Petroleum Engineering Exhibition, opened on Wednesday, June 18, at Olympia, London, and will continue until Saturday, June 28. In the past the exhibition has been associated with the Engineering and Marine Exhibition and this year is the first occasion on which the exhibition has been held independently. It is sponsored by the British Chemical Plant Manufacturers Association and the Council of British Manufacturers of Petroleum Equipment. On the stands is shown equipment which demonstrates the advances made by British engineers in the design and manufacture of oilfield units, oil refinery components, plant for chemical works, and a wide variety of essential auxiliary equipment. There are examples typical of some of the larger items of oil refinery and chemical plant, but many of the larger schemes are, of necessity, represented by models, line diagrams and photographs, which clearly indicate the scope of the work involved in the construction of large installations. A wide variety of ancillary fittings are displayed and cover pumps of all kinds and sizes, and of materials suitable for handling corrosive as well as non-corrosive fluids, large and small valves, mixers, separators, and electrical control systems. Prime movers on view include diesel engines and gas turbines, and there is displayed a wide range of electric motors and portable power stations. At the other end of the scale from the large units are the recording instruments of various categories, together with examples of laboratory equipment.

### Power Gas Corporation, Ltd.

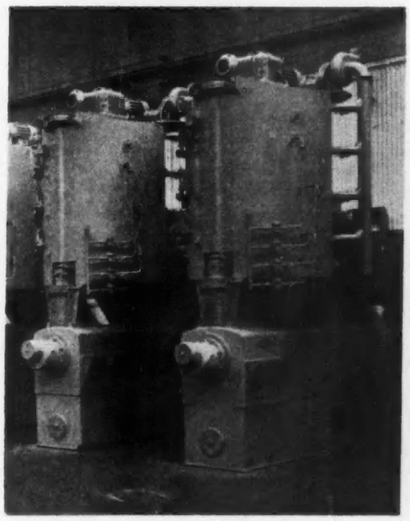
The Power Gas Group of Companies is represented by particular items of the wide range of equipment designed and manufactured for the chemical and petroleum industries. A Mark ET heat exchanger manufactured for light diesel oil to crude oil application is shown and incorporates a tube bundle measuring 192in by 30in diameter. A model of the Segas catalytic oil gas plant, as built at the Isle of Grain refinery, is exhibited. It represents a plant capable of handling feed stock from light distillates to heavy oil of up to 1000 seconds viscosity Redwood No. 1, and designed to produce 16,000,000 cubic feet per day of town gas when gasifying heavy oil, and 20,000,000 cubic feet when gasifying light distillates. Three main vessels, namely, the steam preheater, a reactor containing a catalyst, and an air preheater, form



Glass working model of " Krystal " crystalliser

the unit, and there is also a wash box to take out the heavy tars and other ancillary equipment.

A glass working model of a crystalliser, employing controlled crystallisation by the "Krystal" process, is on view, and the crystalliser, seen in our illustration, is not scaled down from an actual plant, but is intended to show the flow pattern applicable. A " D" pattern Maxoil-Duplex expeller, with a four-stage, 4ft 3in diameter continuous cooking kettle, can be seen. This machine, manufactured by Rose, Downs and Thompson, Ltd., is designed for the expelling of almost all commercial oil seeds, particularly the softer seeds. A battery of such units can be seen in the photograph reproduced herewith. Flow diagrams illustrate the high-temperature heating plants using Bertrams/Rosedowns system, which gives temperatures up to 700 deg. Fah. at very low pressures. A special item is the four-way valve which is used for the control of secondary heating circuits from a constant-temperature primary circuit. A large number of sample welds are on view and include a variety of metals welded by different processes and subjected to preheat treatment and post-heat treatment at specific temperatures.



Group of " D " type " Maxoil-Duplex " oil expellers

### Humphreys and Glasgow, Ltd.

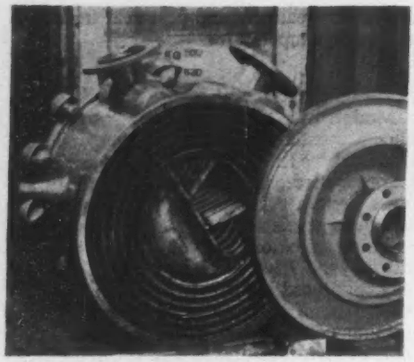
Models of two major projects at present under construction by the company are exhibited by Humphreys and Glasgow, Ltd., Carlisle Place, London, S.W.1. They are a gas plant at Partington and a high-pressure complete gasification plant at Westfield, Fife.

The installation at Partington will have a capacity of 7,500,000 cubic feet of gas per day, produced cheaply from a range of raw materials of low toxicity, and free from sulphur compounds. The gas will be available at high pressure, so that it can be transmitted over long distances without compression. One of the main objects of building the plant, which will produce town's gas by a sequence of continuous automatically controlled processes, is to hasten the full-scale development of a process to produce gas by hydrogenation of oil or coal and help to solve Britain's problem of low-grade coal. The system of the Partington plant is the production and purification of hydrogen in excess of 90 per cent purity by the gasification of oil, and later coal, at 400 lb per square inch by reaction with steam in oxygen at 2500 deg. Fah., and the use of this hydrogen for the production of rich gas by hydrogenating further oil or coal to produce gas having a calorific value of about 600 B.Th.U. per cubic foot. Dilution to the required calorific value is by nitrogen and it is expected that the carbon monoxide content will be as low as 1·5 per cent.

The second model is of the " Lurgi " high-pressure gasification plant in which gas can be made from low-grade coal containing up to 25 per cent ash and 16 per cent moisture. A production of 30,000,000 cubic feet of gas per day is expected in two stages and the gas leaving the plant at 250 lb per square inch will be delivered over a large area by a high-pressure and medium-pressure grid. The coal will be completely gasified in the " Lurgi " generators at a pressure of 25 atmospheres in a continuous stream of oxygen and superheated steam and the proportion of hydrogen increased by a catalytic conversion plant. Next, the carbon dioxide is " washed " out and the gas enriched by the hydrogenation of oil and finally it passes through a benzole recovery plant, pressure oxide purifiers and has the final traces of hydrogen sulphide removed. The gas, which will have a calorific value of 700 B.Th.U. after enrichment by the hydrogenation process, will be diluted with nitrogen to bring the calorific value down to 450 B.Th.U. per cubic foot.

### The A.P.V. Company, Ltd.

Exhibits shown on the stand of the A.P.V. Company, Ltd., Crawley, Sussex, are representative of the services offered by the Chemical Engineering and Industrial Engineering Divisions of the company. Overleaf we illustrate a No. 1 Rosenblad spiral heat exchanger, with a plate area of 62 square feet, which combines low-pressure drop characteristics with a high heat transfer rate. There are three designs of exchanger, the vapour or vapour-gas condenser, the cross flow and the counter current unit, as shown. This is designed for normal counter current liquid/liquid duties in which the hot medium enters at the centre and leaves at the periphery and the cold medium passes in the opposite direction. High uniform flow rates can be maintained at pressures up to 150 lb per square inch. The unit consists essentially of a flat plate wound from the centre on a mandrel to form two concentric passages



No. 1 Rosenblad spiral heat exchanger

and the absence of baffles or other directional changes in the passages enables high velocities to be maintained and so reduces sludge build-up on the heating surfaces. This latter effect assists in attaining a high heat transfer efficiency.

Three "Paraflow" plate heat exchangers represent the range of such units produced and include type HXC, which has twenty-one plates and an area of 38 square feet and can withstand pressures up to 60 lb per square inch. There is also type I.H.M.B., having ninety-one plates and an area of 335 square feet, which operates at hydraulic pressures up to 60 lb per square inch and has a maximum throughput of from 12/15,000 gallons per hour, depending upon viscosity and temperature difference. The third example, type C.H.F., is shown with 121 plates and an area of 557 square feet, and operates at a maximum pressure of 120 lb per square inch, the maximum throughput being 30,000/40,000 gallons per hour.

Also on view are single units of the plate evaporator and separator forming part of a double effect evaporator with thermo-compression. This unit, an example of which is illustrated, operates on the climbing and falling film principle, using plates instead of tubes, the compact arrangement of gasketed plates being held together in a frame. The plates are arranged to meet the required duty and built into units consisting of a rising film inlet and falling film discharge sections and adjacent steam passages. The feed enters the base, boils on contact with the heated plates, rises to the top and transfers to the falling film discharge, and the concentrated product plus vapour is carried into the separator which operates on a horizontal axis, where centrifugal separation takes place.

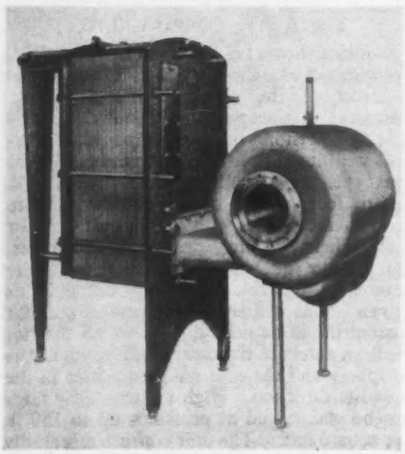
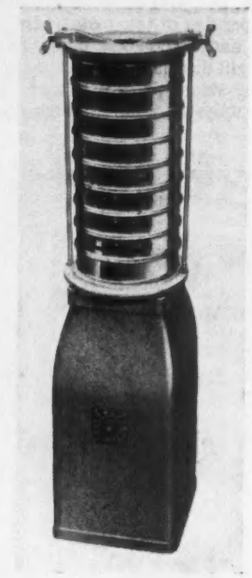


Plate evaporator and separator

### Endecotts (Filters), Ltd.

The full range of testing sieves shown by Endecotts (Filters), Ltd., 251, Kingston Road, Merton Park, London, S.W.19, includes the streamlined "Endrock" testing sieve shaker which is totally enclosed and fitted with anti-vibration mountings. The machine demonstrates the rapid analysis of particles on transparent rimmed test sieves and also the time saved since the operator has only to set the unit, press the built-in time switch and record the results. It will take seven full-height and thirteen half-height test sieves of 6in or 8in diameter, which are carried on a rubber-lined table and held in place by a clamping plate which slides vertically between rods and can be locked at any height by wing nuts. The sieve table, which does not rotate, is inclined from the vertical at about 15 deg. and this angle is maintained constant although the direction of inclination is changed progressively in a clockwise direction. In addition to this movement, the table is given a vibration at a frequency of 300 pulses per minute and an amplitude of $^{5}/_{32}$in. Power is provided by a fractional horsepower, a.c., single-phase motor and the built-in time switch can be set for tests having a duration up to sixty minutes at one minute intervals. The machine, as illustrated, measures 14in by 12in by 42in and weighs 1¼ cwt.



"Endrock" sieve shaker

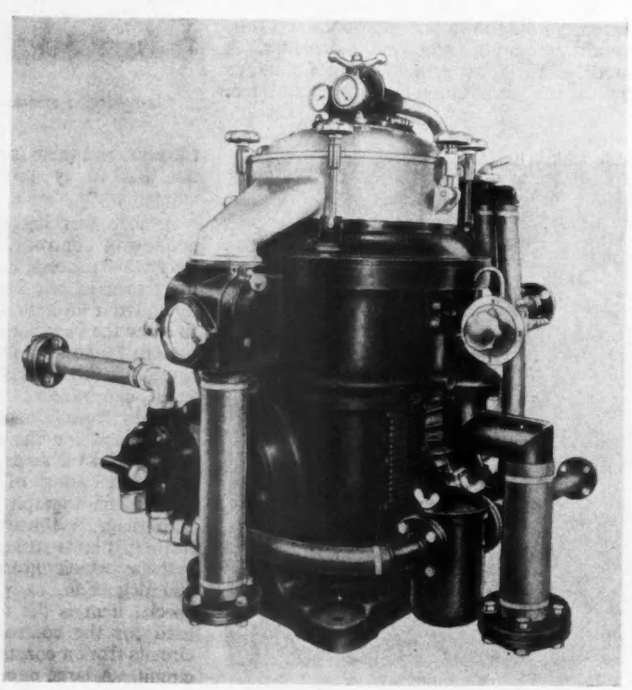
### Robert Jenkins and Co., Ltd.

On the stand of Robert Jenkins and Co., Ltd., Wortley Road, Rotherham, there is shown a mild steel ring clamp boltless door with a short flanged extension for fitting it to an existing welded mild steel, 6ft diameter, vertical vessel having a working pressure of 25 lb per square inch. The ring clamp consists of a number of mild steel clamps, between two mild steel rings, arranged at similar intervals to notches in the door flange. Each notch is wide enough to allow a clamp tongue to pass through when the door is to be opened or closed and, by rotation of the ring clamp, the clamp tongues engage the door flange tongues. The pressure load on the door is taken by the opposing tongues, while a positive pressure seal is ensured by a rubber gasket which suffers no wear since the door does not rotate. Locking devices and other means ensure that the ring clamp will not move while the vessel is under pressure.

Also displayed are two "Polybloc" heat exchangers, both of which have the welded metal casings cut away and the graphite blocks sectioned to show the axial and radial flow passages. These passages are arranged to create a highly turbulent fluid flow and thus the maximum heat transference. Standard unit elements are used which makes it possible to assemble a heat exchange area of any desired size in one apparatus and to meet variations in processing requirements. Examples of welded plant are on view and include a mild steel drum 18ft 9in long by 3ft diameter, designed for a working pressure of 660 lb per square inch, a 2ft 8in diameter stainless steel sphere to hold gases at a pressure of 1650 lb per square inch, and a 24in diameter chamber for operation at high vacuum.

### Alfa-Laval Company, Ltd.

Some of the latest additions to its range of centrifugal separators are shown by Alfa-Laval Company, Ltd., Great West Road, Brentford, Middlesex, and include a standard



De Laval "PX. 207–20S" automatic self-opening centrifugal separator

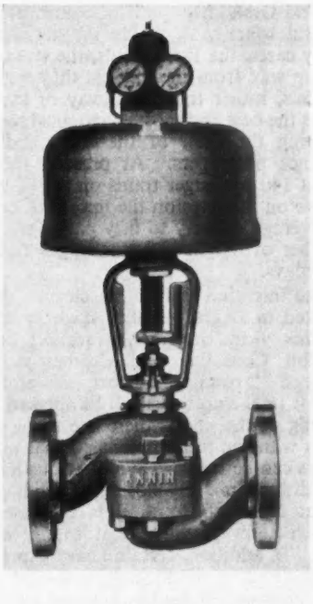
model and the smaller of the two sizes of automatic self-opening units at present being manufactured. These are designed to eject separated solids from the bowl in the water phase without oil loss, while the machine is running at full speed, so that there are no shut-downs for bowl cleaning. The provision of an automatic timing device eliminates the need for manual supervision. Since the sludge space is of large capacity, there is a considerable running time between bowl shootings, and the conical sludge walls ensure complete discharge. The smaller, Mark PX.207-20S size, which can be seen in our illustration, is fitted with a built-in paring disc discharge for light-phase liquid, so that an oil discharge pump is not required. The paring disc can be best described as a reversed centrifugal pump. The unit is powered by an 8 h.p. motor and has a throughput capacity, when treating fuels at a temperature of 180 deg., which ranges from 450 gallons per hour of fuel at 3500 seconds Redwood No. 1 viscosity to 712 gallons per hour when the fuel has a viscosity of 200 seconds.

Also seen on the stand is a new laboratory centrifuge "Lab 201," which follows the pattern of the larger industrial units and forms a useful tool for laboratory and pilot-scale work. "Lab 201" is operated at a speed which gives centrifuging comparable to commercial separators and reaches full separating efficiency in thirty-five seconds from starting up. It operates from a 220V, a.c., single-phase circuit and the power consumption is between 0·3kW to 0·35kW, while its capacity ranges up to 22 gallons per hour, depending upon the nature of the sample of liquor.

### Audley Engineering Company, Ltd.

Examples of the "Audco Annin" valves can be seen on the stand of the Audley Engineering Company, Ltd., Newport, Shropshire, which has entered into agreement with the Annin Company of Los Angeles to produce them in this country. The valves are designed to solve complex fluid control problems concerned with hot, cold, erosive, corrosive, or viscose liquids, handled in chemical, petroleum, paper and steam power plants. Of split design, the valve consists of an adaptor and a globe body which provides for conversion into straight-through angle or three-way forms. This split construction provides a single-seat design which retains an internal contour of the same area as the relating pipe and the body flanges retain the seat ring in alignment with the valve plug, so that lapping of plug and ring is not required. Easy replacement of the valve seat can be carried out when the body members are separated and the seat is not affected by pressure or thermal shocks. Contoured valve plugs provide either linear, percentage or semi-throttle characteristics and reduce turbulence, vibration and noise.

There are three forms of operating equipment, namely, "Domotor," cylinder and manual. The Domotor, illustrated herewith, has a pneumatic operator, and is available in A.S.A. ratings of 150 lb, 300 lb, 600 lb, 900 lb and 1500 lb. The unit consists of a dome with a built-in positioner and piston providing power for accurately positioning the valve stem regardless of varying stem forces. Cylinder-operated valves have quick-acting cylinder equipment using air or gas up to 150 lb per square inch, while manual control units are suitable for precise throttling of flow rate and tight closure.



Audco Annin "Domotor" control valve

### British LaBour Pump Company, Ltd.

A range of pumps especially designed for use in the chemical industry has been introduced recently by the British LaBour Pump Company, Ltd., Blundell Street, London, N.7, and are shown on the company's stand. These Mark 5Z pumps handle dirty liquids and gas/liquid mixtures and particular attention has been paid in the design to ensure ease of maintenance, the impeller and internal components being removable without disconnecting suction and discharge lines or disturbing the motor. The fully-open impeller sweeps the casing so that only a low positive suction head is required and is separately mounted on its shaft and has no sealing rings or closely fitted running parts. The wetted end of the pump consists of the pump casing, cast integrally with inlet and outlet passages, and the pump back.

Capacities range from 10 to 60 gallons per minute up to 250ft head with shaft speeds of 1450 to 3500 r.p.m. on the smaller units and to 400 gallons per minute at 90ft head at 1450 r.p.m. on the larger.

Other pumps on view include the UZ unit, for handling hydrochloric acid and ferric chloride solutions, and the USL pump, designed specifically for mines and to operate in confined spaces. It is self-priming, does not require lubrication or external cooling, and will run for long periods on "snore."

### The David Brown Companies

On the stand of the David Brown Companies, Meltham, Huddersfield, Yorkshire, is a 24in oil pipeline valve manufactured by the David Brown Foundries Division, Penistone, Sheffield. Some of these valves are illustrated. Valves of 16in, 24in and 30in have been produced and the bodies, which are required to withstand pressures up to 2400 lb per square inch, are cast in carbon steel and moulded in three sections, submerged arc welding being used to join the castings. Inside each valve a split gate consists of a gate and segment sliding in a "V" groove. Molybdenum steel is used for the gate and segment sections and stainless steel for the seating, all of which are ground to limits of 0·002in and chromium-plated. Pressures up to 1000 lb per square inch must be withstood on both gate and segment sides of the valve seating.

Various castings are on view as are also recent additions to the speed-reducing and

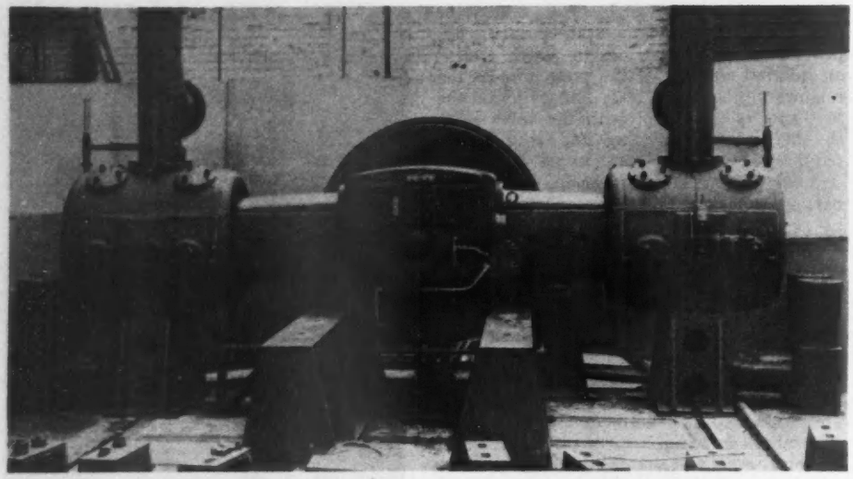
24 inch pipeline valves

increasing units from the Gear Division. These include an R.H.V. gear with output shaft at right angles to the input shaft, and two recent additions to the range of gearing products, the "Varicon" stepless speed reducer and the size 2¼ "Radicon" double-reduction worm reducer. In the "Varicon," which is designed for drives up to 5 h.p., power is transmitted partly by hydraulic and partly by mechanical means. The size 2¼ "Radicon" unit, one of a range varying from 1¼in to 28in centres, is designed for low-powered, slow-moving drives. It is available in fifty-three ratios, ranging from 65 to 1 to 3600 to 1, with a range of output torque between 1270 lb and 3300 lb per inch at input speeds from 500 to 3000 r.p.m.

### Consolidated Pneumatic Tool Company, Ltd.

Among the power tools and compressed air equipment displayed by the Consolidated Pneumatic Tool Company, Ltd., 232, Dawes Road, London, S.W.6, is a representative selection of a new F. E. range of stationary compressors which are of horizontal, balance-opposed design. On the same crankcase and running gear different sizes and numbers of cylinders can be mounted to give outputs up to 5000 cubic feet per minute or pressure up to 3000 lb per square inch within the horsepower range 200 h.p. to 350 h.p. for the two-cylinder unit and 350 h.p. to 700 h.p. for the four-cylinder model. We illustrate a Mark F.E.21, single-stage, double-acting, two-cylinder, water-cooled compressor having cylinders of 19½in bore by 12in stroke, and designed for an output of 2400 cubic feet per minute at 40 lb per square inch at 375 r.p.m.

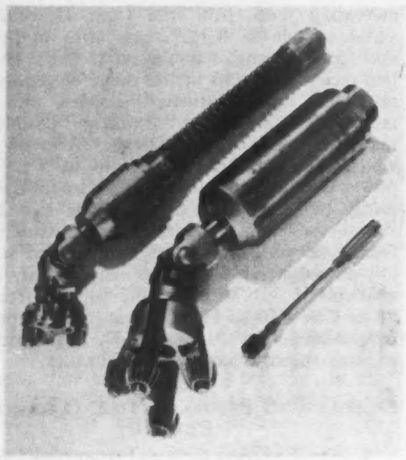
The crankcase part of the frame is fabricated and fully stress relieved and is boxed in by a heavy steel plate. High-strength alloy steel bolts secure the cast steel main bearing caps and the normalised forge



Mark "F.E.21" single-stage, double-acting, two-cylinder, water-cooled compressor

carbon steel crankshaft is carried in bearings having bronze shells white metal lined. Similar bearings are employed at the crankpin end of the connecting-rods, which are drop forgings of high quality carbon steel and are fitted with a phosphor-bronze bushing at the crosshead pin end. The cast Meehanite crossheads are of box construction, and guide housings are of the same material.

Three sizes of Lagonda tube cleaner motors fitted with typical cutter heads on the larger units and a brush on the small unit are illustrated herewith. These air-powered units



Lagonda tube cleaners

are being manufactured by the company under licence in what are known as the "600," "1100" and "1300" series, which cover straight and curved tubes ranging from ¾in to 6in diameter. Small tubes are catered for by the "600" series, and the "1300" series has a tube range of 1¾in to 4¼in, while the "1100" series covers tubes having an inside diameter from 2¼in to 6in.

W. J. Fraser and Co., Ltd.

Models and diagrams illustrate the large and medium-scale process plant engineered by W. J. Fraser and Co., Ltd., Harold Hill, Romford, Essex, the models representing a fertiliser plant, a solvent recovery plant and a plant for the desulphurising of coke oven gas and the manufacture of sulphuric acid. This latter plant is designed to remove 90 to 97 per cent of total sulphur from 1,350,000 cubic feet per hour of raw coke oven gas and to produce 37 tons of 98 to 100 per cent sulphuric acid per day. As examples of special-purpose plant, there are two working models—the Nauta mixer and the Fraser pin granulator.

The Nauta is a counter current mixer, for liquid/solid or solid/solid mixing, which has a high mixing efficiency, low mixing time and power consumption, together with a wide tolerance of variations in weight or particle size. The cone-shaped body incorporates a revolving inclined mixing screw which conveys the material up the sides of the mixer, so that the material tends to flow by gravity down the opposite side. These vertical and horizontal movements set up by the screw plus the converging effect as the material falls to the bottom of the cone ensure quick and efficient mixing. Differences in specific gravity or air resistance have no effect, since the materials are not subject to air dispersal and remain virtually in a compact mass. Mixing time ranges from two to eight minutes and the energy required amounts to 4 h.p. to 5 h.p. for 600 imperial gallons.

Primarily intended for use as a pre-granulator, the Fraser pin granulator has been developed in co-operation with Scottish Agricultural Industries, Ltd. Apart from special applications in the manufacture of fertilisers, it is suitable for use where fine materials are to be agglomerated and also where materials are difficult to granulate. The machine consists of a horizontal cylindrical trough containing a longitudinal shaft fitted with two rows of pins arranged helically in order to carry the material along. The shaft is driven at high speed so that the material and water are kept in agitation and agglomerate to form small granules.

*(To be continued)*

## Midland and Great Northern Joint Railway

At the end of last week, the Eastern Area Board of the British Transport Commission announced that the railway hitherto known as the Midland and Great Northern Joint Line must be closed down. This line runs from Edmondthorpe (near Melton Mowbray) and Peterborough to Sutton Bridge, and then to Melton Constable, from which junction there are three branches to Cromer, Norwich and Yarmouth, respectively. The total length is 180 route miles, serving sixty-five stations and halts.

The Midland and Great Northern Joint, as it is still commonly known, is a railway relic of last century. It originated from the activity of a number of small independent companies which gradually amalgamated; the first section from Spalding to Holbeach was opened in November, 1858. In 1866, the Midland and Eastern Railway was formed to take over the line from Bourne to King's Lynn and exercise running powers to Peterborough. The Midland Railway had already secured the working of the Peterborough, Wisbech and Sutton Bridge line and, with the Great Northern Railway, jointly worked the lines between Bourne and King's Lynn. A few years later construction of the lines in the northern part of Norfolk began. There were further amalgamations in 1883, by which time the line was complete between Bourne and Peterborough and Norwich and Yarmouth via Melton Constable and North Walsham. Construction of a branch from Melton Constable, through Holt, to Cromer was completed in 1887. About the same time a connecting link was made between South Lynn and Bawsey. No further construction was undertaken until the incorporation, in 1893, of the Midland and Great Northern Railway Joint Committee. In the same year the line, as it now exists, was completed by bringing into operation a short length avoiding Spalding and another length from Bourne to join the Midland Railway at Little Bytham. The standing of the Midland and Great Northern Joint was unchanged by the railway grouping of 1921, except, of course, that its owning partners, the Midland and Great Northern, became merged in the L.M.S. and L.N.E.R. companies respectively. Passenger and goods traffic continued to be controlled from King's Lynn until October, 1936, when the working responsibility was taken over by the L.N.E.R. and, subsequently, by the Eastern Region of British Railways upon nationalisation in 1948.

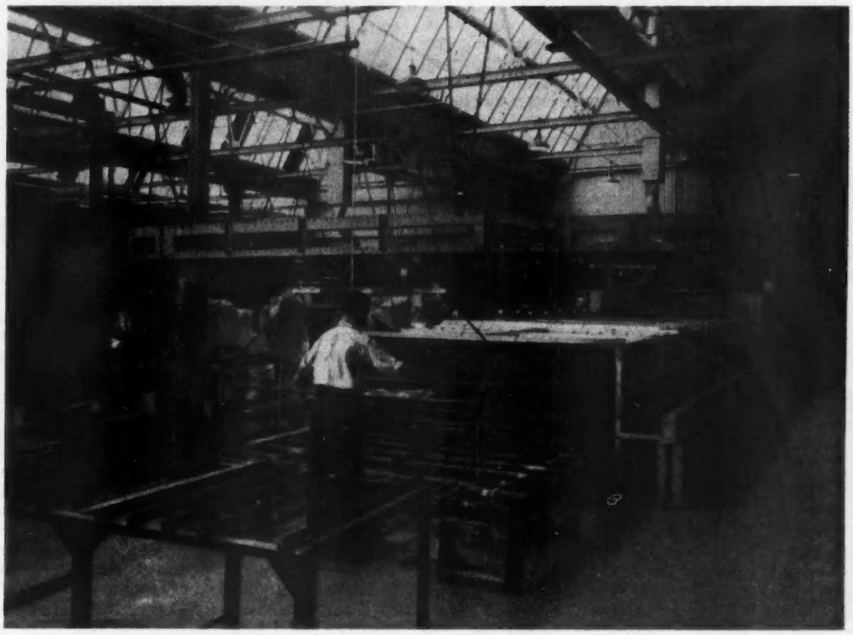
The Eastern Area Board of the British Transport Commission has explained that, for many years, the line has been operated at a considerable working loss. No place served by the Midland and Great Northern Joint is more than a few miles from the Great Eastern line which parallels it across the northern part of East Anglia, and throughout most of the route there are bus services. It is this duplication of facilities, the Area Board says, which is mainly responsible for the poor loadings experienced on the M. and G.N. line, apart, of course, from the general sparsity of traffic in the area. In many cases, the Board adds, the stations are a long way from the villages they serve and the bus, rather than a railway or tramway, offers the best and most economical means of carrying the bulk of the local and short distance passengers. At present, there are about 140 passenger trains on weekdays and twelve on Sundays on the line, each carrying an average of forty to fifty passengers; the number of freight trains averages eighty on weekdays.

The intention is that the closure shall be effected in stages, the first stage by the end of this year, though the section between Melton Constable and Cromer is to be retained "pending further examination." About 1500 employees will be affected by the closing of the line; there are to be discussions with the trade unions so that arrangements can be made to avoid serious hardship and dislocation. By closing the Midland and Great Northern Joint, it is estimated that British Railways will save at least £500,000 a year. In addition, certain heavy expenditure on engineering work, such as the rebuilding of Clenchwarton Bridge, will not need to be incurred.

# Fabrication in Glass

*Laminated glass construction has been applied to heavily curved windscreens and to electrically heated windows. We recently observed some of the techniques of manufacture of such items.*

THERE is now in production at the King's Norton, Birmingham, factory of the Triplex Safety Glass Company, Ltd., a new department specialising in curved laminated glass panels, principally for use as windscreens and rear windows in cars. It is worthy of note that a wrap-round window of laminated glass deserves to be regarded as an example of cost being deemed secondary, for either complex curvature or laminated construction render the product about two and a half times as expensive as a simply curved toughened screen. In the case of complex curvature this is at least partly because the parts cannot be stacked closely together and take up far more room in storage or carriage than cylindrical sections; for this reason the production of wrap-round screens is carried out on a three-shift basis and only small batches are allowed to accumulate in the works.



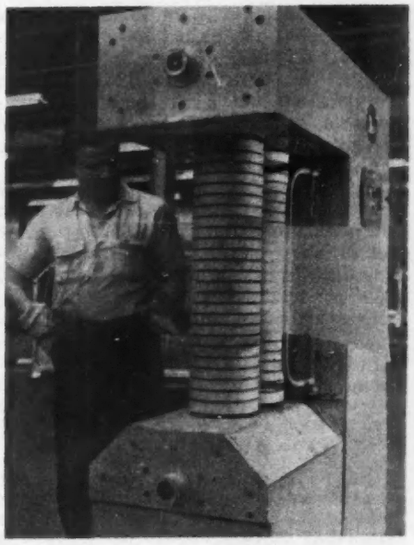
A pair of curved sheets being removed from the mould on which they have been passed through the furnace

The early stages of the manufacture are common to all windscreens, the glass being inspected by eye for defects and the outline of the required shape being copied from a template into the glass by a tungsten carbide wheel or a diamond. The unwanted glass outside the trace is then broken away by hand: the delay permissible between marking and breaking out is increased by moistening the vicinity of the mark within paraffin before cutting. The sheet destined to become the outer layer of a curved window is cut correspondingly larger than the inner.

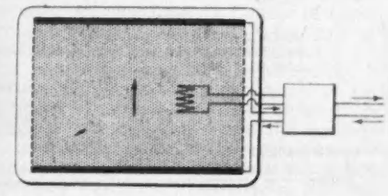
A pair of sheets, outer downwards, is then laid on a mould and enters a furnace. The mould may be visualised as resembling a frame for a finished window; when the glass is flat, it rests only on the ends of the mould, but as it softens at high temperature it falls under its own weight until it touches the mould all along its periphery. If the curvature is so great that the points on which the flat plate initially rest are more than ½in from the edges, in which case the marks left there would be visible when the glass was mounted, a hinged flap is fitted at each end of the mould to carry the flat plate; the two flaps are coupled together so that both ends move inwards together as the glass bends. For wrap-round screens even more elaborate moulds are used, the end sections of the mould being hinged so that the sharp curvature near the ends is not impressed until after the centre has settled on the mould. This is achieved very simply by counter-balancing the hinged ends so that they tend to fold up, and only the weight of the flat sheets keeps them down; when the glass is sufficiently soft they rise.

Since during this operation the glass bends not only along its major axis but also along the minor axis, it is essential that a pair of sheets is moulded together and subsequently assembled together. The glass is heated by radiation from above, so that the inner sheet is always hotter and there is no doubt about the adjoining faces conforming. To prevent the two sheets sticking at this stage, they are separated by a sprinkling of fine powder. It would be difficult and expensive to remove this powder, since washing would involve cooling and drying the glass, so colourless crystals having the same refractive index as the interlayer are used, and they become invisible in the finished product; a diatomaceous earth satisfies these requirements.

From the mould the pairs of sheets are passed into a dehumidified dust-free room where they are separated, the inner faces blown clean with compressed air, and a layer of "Vinal" interposed. This interlayer, about 0·015in thick, is of polyvinyl butyral manufactured in the United States by the Monsanto Chemical Company, and for curved screens a rather soft mix, incorporating much plasticiser, is used. The assembly, with the two sheets of glass replaced precisely in their original relative positions, is then heated by electric radiant elements and passed between rubber rolls to eliminate air from the interfaces; our illustration shows how this operation causes the "Vinal" to cease to appear translucent. Adhesion is not yet complete—the glass has a streaky appearance—and packs of plates are then placed in an autoclave and raised to about 100 lb per square inch and 100 deg. Cent. The parts are then allowed to cool, checked on fixtures for shape, examined visually for flaws, and passed out.



A wrap-round windscreen assembly is rolled into a state of adhesion



Gold film panel with sensing element and relay

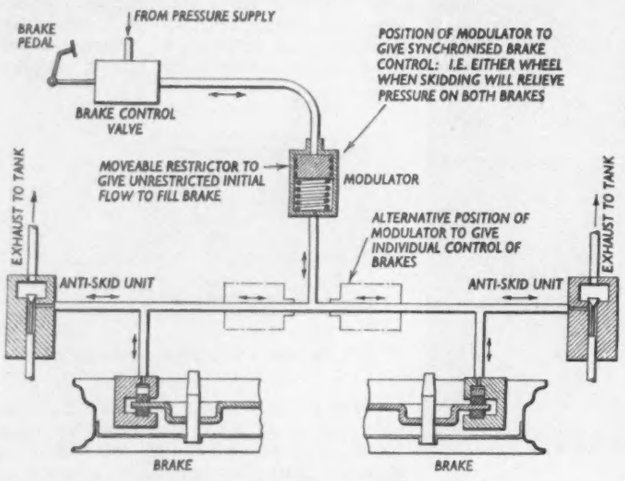
When we visited the factory recently to see curved screens, both laminated and toughened, being produced, we also saw examples of electrically heated glass able to resist the forming of mist or ice on its surface. Already in use for such purposes as the rear windows of cars and the bridge windows of ships are wired windows in which a grid of wires 0·0008in or 0·001in diameter are embedded in the plastic interlayer. These usually have a resistance of the order 1–10 ohms and are well adapted to automobile and aircraft supply voltages of 6V to 28V. The wired windows have the disadvantages that although the wires are oxidised dark blue, they do glitter under illumination, and that the heated area must be made up of rectangular strips which end at least ½in from the periphery. These criticisms do not apply to Triplex "G.F.," a coating of gold film about $2\times10^{-7}$in thick, which was described in more detail in our account of the Physical Society Exhibition this year (April 4, page 500). This coating has a resistance of 10 ohms for

a square area and may run at voltages from 24V to 240V, the heated area being subdivided to suit the heat release to the available voltage. Small panels may be made from two $\frac{1}{8}$in sheets, but $\frac{1}{16}$in is the normal minimum total thickness; panels up to 30in by 42in are available, and curvature up to a depth of 1in can be encompassed.

The heat inputs to windows naturally vary widely, from 30–36W per square foot on drivers' windscreens to 200–400W per square foot for demisting and 400–800 for anti-icing on aircraft. Where the input exceeds 100W per square foot a thermostatic over-temperature protection is necessary, since a temperature of 80 deg. Cent. will cause the "Vinal" to bubble or may crack the glass. For this purpose a length of pure nickel wire having a resistance between 25 and 100 ohms at 20 deg. Cent. is incorporated; when the heating is turned on current is passed also through this element, and at the desired maximum temperature the current through the detector will fall low enough to allow a control relay to open and cut off the supply to the gold film. Such a windscreen assembly is shown in our diagram; control units to monitor such a screen are manufactured by Wynstruments, Ltd., for ships and the Plessey Company, Ltd., for aircraft.

# Wheel Lock Inhibited Braking

ANTI-SKID devices are already established equipment for aircraft, since not only is the ability to stop short of the aerodrome boundary occasionally priceless, but also the energy to be dissipated is high enough to destroy a very expensive tyre if a wheel is allowed to lock. There are good reasons for applying such devices to surface vehicles also: it will be recalled that the chance of jack-knifing a vehicle and trailer on a slippery surface has been demonstrated to be much reduced by so doing. Others, perhaps less obvious, are that it becomes much safer to manœuvre a vehicle under braking, since the tendency to lock the wheels from which the weight is transferred is nullified; that the distribution of braking effort between front wheels and back wheels, or between two axles with weight transfer under braking, must no longer be a compromise bound to betray the designer under some circumstances, and that braking power as great as can be employed at high speeds, when the rolling inertia gives an anti-skid effect, can be built in without rendering the controls treacherous at low speed.


FROM PRESSURE SUPPLY
BRAKE PEDAL
BRAKE CONTROL VALVE
POSITION OF MODULATOR TO GIVE SYNCHRONISED BRAKE CONTROL: I.E. EITHER WHEEL WHEN SKIDDING WILL RELIEVE PRESSURE ON BOTH BRAKES
MOVEABLE RESTRICTOR TO GIVE UNRESTRICTED INITIAL FLOW TO FILL BRAKE
MODULATOR
ALTERNATIVE POSITION OF MODULATOR TO GIVE INDIVIDUAL CONTROL OF BRAKES
EXHAUST TO TANK
EXHAUST TO TANK
ANTI-SKID UNIT
ANTI-SKID UNIT
BRAKE
BRAKE

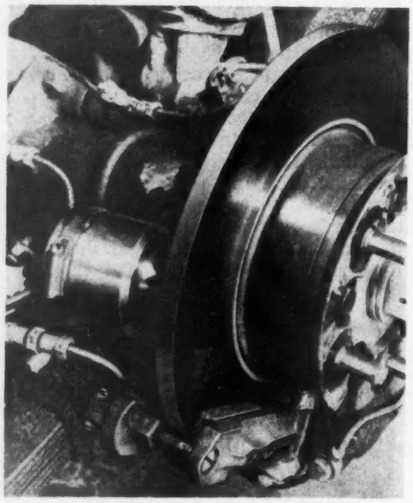
**Diagrammatic view of the anti-skid installation**

Accordingly, the Dunlop Rubber Company has evolved from its "Maxaret" anti-skid unit for aircraft (described in some detail on October 3, 1952, page 460) a corresponding device for road vehicles. The principle is the same, that at a certain level of angular acceleration, detected by a flywheel, a valve in the brake power line is actuated to relieve the brake application pressure. Such a system is, of course, strictly limited to vehicles with power-operated brakes, and since it is adversely affected by any changes in the operating pressure/brake torque relationship, it is most easily applied to a disc brake. A trial installation has been made on a Jaguar Mk. VII, using an engine-driven pump, aircraft hydraulic reservoirs, and Dunlop disc brakes. The acceleration sensors are gear driven from the disc itself, as also are tachometer generators on the rear wheels (there was no room for generators on the front wheels). The hydraulic circuitry differed from that of aircraft in that the anti-skid unit, instead of being fitted between supply and brake and acting as a two-way valve directing high-pressure oil either to brake or low-pressure sump, is by-passed by the supply line and has to act only as an on-off cock; this is found to result in a less abrupt action which, in view of the lower suspension frequency of road vehicles, is desirable. Since the purpose of inhibiting the braking system against locking the wheels is largely to preserve the controllability, the installation is designed not to allow a large difference between braking forces on each side of the car to develop; this is achieved by positioning the restrictors, across which a pressure difference appears when the anti-skid unit raises the flow through the brake motor, in pipes common to both front brakes and both rear brakes. These restrictors take the form of a spiral groove around a moving piston; the initial application of the brake is unhindered by the restricted flow past the piston, since the piston can move in the brake "on" direction against a spring, coming up against an abutment almost as soon as the anti-skid units operate.

The trial installation is elaborated by strain gauge pressure transducers adjoining the brake cells and Electromatic valves to isolate the anti-skid units, switched to allow either or both front and rear pairs to be selected. A multi-channel optical oscillograph produces a photographic record on a time base of all brake pressures, hydraulic supply pressure, speed of each rear wheel, and apparent acceleration along the longitudinal axis of the vehicle. In addition, stopping distances have been measured directly by the use of an explosive road marker.

Results have confirmed the design performance of the device and the expected improvement in braking power. On a dry coarse asphalt surface using treaded tyres, a stop from 67 m.p.h. took 232ft using anti-skid and 248ft when a high degree of driving skill was used to avoid wheel locking. In the same conditions overall accelerations of 0·61 *g* from 76 m.p.h. and 92 m.p.h., using anti-skid, have been derived from stopping distance measurement. (The road marker was fired from the brake pedal, so that distance measurements can only err in the pessimistic direction.) The driver of the car can feel the anti-skid system operating, but the change in acceleration is at something near to suspension frequency and might well escape observation if one was not watching for it.

As has been explained, the application of such an installation is considered most desirable on chassis such as are associated with goods vehicles, and hardly necessary for cars driven at the speeds used in this country, although interest has been shown in all fields from countries where distances demand and roads allow high performance vehicles. While for the lighter vehicles hydraulic brake actuation is well established, and a power system has already been introduced by Citroen, the trend on heavy vehicles appears to be towards standardising air braking. Such operation is unwelcome, if not incompatible, with anti-skid devices, since the response time of an air motor tends to be long and variable with the braking effort in use. However, hydraulic operation has great advantages for critical systems such as power steering, and it will be recalled that a hydraulic system for steering, braking and door actuation incorporating accumulators has already been proposed by Lockheed. Where hydraulic power is intended to run the brakes only, Dunlop suggests that a minimum of difficulty in adapting to an existing vehicle would be met if the hydraulic pump were driven by an air motor exhausting into the induction manifold of a throttled engine. Provision would be made so that, if the supply failed, after the reservoir had been exhausted the brakes were applied by travel of the pedal in the conventional way (operation of the power valve needs very little movement), the extra pedal movement automatically isolating the anti-skid devices to prevent irreplaceable energy being dissipated through them.



**Rear brake of trial installation: in the foreground is the acceleration-sensitive valve, and beyond the axle can be seen the wiring of the speed transmitter**

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INSTITUTE OF MARINE ENGINEERS.—A paper with the title "Supercharged Boilers for Marine Application" was read recently by Mr. E. L. Daman before the Institute of Marine Engineers. The author considers that the continued interest of both naval and marine engineers in improving fuel consumption, reducing weight and space, and simplifying construction of propulsion plants has led many engineers to view the supercharged boiler as offering a promising step in this direction. The paper discusses the steam component of a supercharged or combined gas turbine steam boiler plant and considers the general design for supercharged boilers and also outlines the main points of a boiler at present in operation. Weight and space comparisons between conventional and supercharged boilers are presented, while the performance data of a supercharged boiler is analysed and compared with a conventional unit of equivalent capacity. Results of fuel oil treatment tests are briefly dealt with and an outline given on the problems of matching a supercharger set to a supercharged boiler, together with a numerical presentation showing the effect of mismatching on boiler weight and performance. The paper concludes that the benefits from a supercharged system have been proved by theory and practice to be attractive, and that operating experience has shown that such systems can be built having a reliability comparable with the conventional.

# SHORTER REPORTS

## Fuel-Flow Test House

A NEW fuel-flow test house, claimed to be the most extensive of its kind in Europe, was opened on June 6 by the Minister of Supply, Mr. Aubrey Jones. The test house has been set up by Firth Cleveland Instruments, Ltd., a recently formed subsidiary of Simmonds Aerocessories, Ltd., at Treforest, Glamorgan. Facilities are provided for testing flowmeters, water separators, valves, &c., and there is apparatus for use in future development. The company states that tests to Government and other specifications can be carried out on behalf of any manufacturer in the United Kingdom and western Europe.

The establishment has a pumping station and fuel storage tanks in addition to the test house. The latter contains three laboratories. In one of them are the instrument test rigs, flowmeter, and flight simulator ; in a second is the equipment for testing water separators, filters, strainers, valves, &c.; and the third is a control room. Fuel from the main storage tanks passes through the pumping station and is distributed to the test rigs. After traversing the water separator test rig, fuel is pumped back into the main tanks. The flowmeter test rigs each have a pump and reservoir, and are self-contained ; the fuel is diverted into a weighing tank when testing. After tests it may be transferred back into the storage tanks. During tests the fuel temperature may be taken to between −40 deg. and +55 deg. Cent. "Dekatron" scalers and attendant pulse generators are used to measure the flowmeter transmitter frequencies and the time taken to fill the weighing tanks. There is a 400 c/s power supply for the flowmeters, and double-beam oscilloscopes and ancillary test gear are provided. Mass flow is measured by Avery weighing machines fitted with contacts for the timing devices and the load indicators. It is stated that, with the aid of this gear, the rate and the amount of the flow can be measured to within 0·2 per cent. Other liquids besides fuels can be used in the circulating rigs.

Flowmeters are tested and calibrated in a fuel line under simulated flight conditions. The average rate of flow and the quantity of fuel passed are measured. Flow rates can be obtained ranging from such as are employed nowadays in aircraft to such as the company anticipates may be used later. We understand that a variety of hydrocarbon fuels is available in the storage tanks, and the establishment may be extended to deal with more exotic fuels in time to come.

Pumps supplying up to 60,000 i.g.p.h. are used in testing water separators and filters to determine their efficiency. Fresh or sea water can be injected into the stream at 6000 i.g.p.h., thoroughly emulsifying it. Various solid contaminants can also be added continuously to the fuel at predetermined rates. Fluid passing through a combined separator and filter is analysed as follows :—a centrifuge is used to measure the amount of water contained by the influent; Karl Fischer apparatus measures the amount of water contained by the effluent ; the solid contaminants are weighed ; and the size of dust particles is measured by miscroscopic inspection. We understand that all kinds of Simmonds water separators are to be tested under running conditions.

The company informs us further that all types of valve can be tested, and instruments are arranged to indicate the flow at any instant. The rig is used to check and adjust the following of the firm's products :—(i) A water dumping valve automatically operated by a float (this is fitted to drain accumulated water from the sump of a separator) ; (ii) a flow controller designed to work within close limits ; (iii) a shut-off valve designed to interrupt flow when it reaches a nominal maximum rate, but arranged so that restoration of flow is only possible manually.

A control room houses the consoles for the remote regulation of the main text rigs. Fuel flow lines are stated to be controllable either automatically or manually, and automatic test cycles can be programmed.

## Atomic Energy in Australia

A SYMPOSIUM on the peaceful uses of atomic energy was opened in Sydney, Australia, by the Hon. W. H. Spooner, Minister for National Development, on June 2. Senator Spooner's address traced the origin of the occasion back to the 1954 resolution of the General Assembly of the United Nations, relating to the use of atomic energy for peaceful ends. "The promoters of this symposium," said the Minister, "were moved by the same high purposes and principles that lay behind the General Assembly's resolution. These were to disseminate knowledge and to hasten research and development."

During the week of the symposium, 108 papers were presented on materials, power engineering, research reactors, &c., to audiences consisting not only of Australians but also of visitors from Britain, Canada, New Zealand and the United States of America. Thirty-eight of the overseas members of the symposium were official representatives. Visits were paid to the University of Sydney and to the newer but rapidly expanding University of Technology : in both these establishments work on various aspects of atomic energy (often in collaboration with the Australian Atomic Energy Commission) was observed. An especial object of interest was the A.A.E.C. Research Establishment at Lucas Heights, where the 10MW reactor "Hifar," which first became critical on Australia Day this year, is now being brought up towards full power. This reactor is similar to "Dido" at Harwell. About 400 engineers and scientists form the staff at the Lucas Heights laboratories, which cost some £6,000,000 to build.

An atomic energy exhibition was run concurrently with the symposium and was opened (also by Senator Spooner) at the Sydney town hall on June 2. The exhibition included models of power reactors, working demonstrations of the use of radio-isotopes in industry, stands illustrating uranium prospecting and mining in Australia, and displays of how training for work in nuclear technology is carried out. The exhibitors were Atomics International, Inc.; the Australian Atomic Energy Commission ; British General Electric Company Pty., Ltd. ; Davies Kent Pty., Ltd. ; Richard Foot (Aust.) Pty., Ltd. ; A. E. Goodwin Pty., Ltd. ; Kodak (A/sia.) Pty., Ltd. ; Long Industrial Equipment Pty., Ltd. ; New South Wales University of Technology ; Nuclear Power Plant Company, Ltd. ; Pergamon Press ; the Permutit Company of Australia Pty., Ltd. ; Philips Electrical Industries Pty., Ltd. ; Radium Hill Uranium Project ; H. B. Selby and Co., Pty., Ltd. ; Siemens (Aust.) Pty., Ltd. ; U.K. Atomic Energy Authority ; U.S. Information Service ; University of Sydney ; Vokes Aust. Pty., Ltd. ; Watson Victor, Ltd.

## Fire Research

DETAILS of investigations undertaken during the year under review are contained in *Fire Research*, 1957, published for the D.S.I.R. and Fire Offices' Committee by H.M. Stationery Office, price 5s.

One investigation, which was begun at the request of the Building Research Station, is concerned with the part played by the external walls of multi-storey buildings in restricting the spread of fire vertically on the face of a building. Experiments are being made on a full-scale section of a four-storey building consisting of single rooms one above the other. A staircase has been included so that the problem of personal safety in buildings with a single enclosed internal staircase can be studied. These experiments have been repeated with models to compare the growth of fire with that in the full-scale structure. Work has also been carried out on the part which can be played by automatic fire detectors in reducing annual fire losses. The delay from the start of a fire to the beginning of fire fighting was examined.

During the year, the committee on industrial fires and explosions met to consider, *inter alia*, gas and vapour explosions started by friction sparks, the risk of which appears to be marginal. However, investigations were carried out on explosions in ducted systems, both closed and vented, to find how pressures may be reduced to safe values by venting or other techniques. Special attention was paid to the way in which the length and diameter of a duct influence explosions. What are thought to be interesting relationships have been observed. There are indications that a critical ratio of length to diameter may exist, above which there is a rise in the maximum pressure obtained when vents are used.

A draft specification for a roof test has been considered by the British Standards Institution. The test is concerned only with the protection provided by a roof against fire from a neighbouring building and against the spread of flame on the surface of the roof, features required by the Model Building By-laws. Much information is being obtained on the behaviour of various types of roof under test, and trials have been made on twenty-four types of roof for various manufacturers.

In the course of a hydro-electric scheme associated with the Canadian St. Lawrence Seaway project, a number of buildings are being demolished before flooding the land. The Fire Research Section of the Building Research Division, National Research Council of Canada, arranged to carry out full-scale fire tests in a number of the buildings and invited the Joint Fire Research Organisation to co-operate. A member of the staff went to Canada to assist with tests to compare the growth of fire in large buildings with that in domestic and small-scale model dwellings on which some information has already been obtained. The winter temperatures prevailing introduced experimental difficulties. A deflection anemometer with eddy current damping was designed and constructed to measure the rate at which air enters a burning building.

## Higher Speed Water Brakes

A NEW range of Froude hydraulic dynamometers, designed for the testing of engines developing both high powers and high speeds, is now being put into production by Heenan and Froude, Ltd., of Worcester.

The new machines, which will be known as the Froude DA type, will be available in a range of sizes. The smallest of these absorbs 350 b.h.p. at speeds up to 45,000 r.p.m., and the largest 54,000 b.h.p. at speeds up to 8500 r.p.m. Their principal applications will be gas and steam turbine testing.

These dynamometers have been evolved from existing designs by reducing the diameter of the standard rotor by about 25 per cent, which permits considerably higher speeds of rotation for the same peripheral velocities and at the same time has the effect of reducing (in much higher proportion than the reduction in rotor diameter) the velocity with which the water leaves the rotor at maximum duty. Water velocities thus become much more manageable.

The conventional Froude rotor is double-sided, having cups on each side to increase capacity and to neutralise any axial thrust. In the new DA design, however, the rotor is split vertically into two and the two parts separated to form two half-rotors, each with cups on one side only, facing towards each other. Between the two half-rotors is a corres-

ponding set of power absorbing stators fixed to the dynamometer casing. This inversion of the normal Froude arrangement has certain technical advantages, inasmuch as vanes are provided on the back faces of the half-rotors to form a seal which prevents excessive egress of water along the shaft. This, in turn, enables conventional stuffing-box glands to be replaced by clearance spaces and leak-off's, thereby reducing maintenance and shortening shaft bearing centres. The rotors are machined all over, to ensure uniformity of the power absorption cups, and maintain running balance regardless of the amount of water in the cups.

Another departure from previous Froude designs is the absence of the sluice-gate form of control for masking the power absorbing elements to varying extents so as to regulate the load. In the new DA machines, the load is controlled by a development of the " back pressure outlet valve " familiar to users of the large FA dynamometers.

In this form of control, a small water impeller is mounted on the dynamometer shaft : this sets up a water pressure which varies as the square of the dynamometer speed. The pressure is conveyed to the spindle of a double-beat valve which controls the out-flow of water from the dynamometer casing and thus the amount of water contained in the power absorbing elements. Adjustment for a particular load setting is achieved on the standard machines (remote control can be provided at extra cost) by the manual operation of a small bleed-off valve which increases, or decreases, this pressure, determining the back-pressure set up by the double-beat valve and thus regulating the water content and, consequently, the load imposed.

A further design feature is that the dynamometer shaft runs in oil-lubricated plain bearings : the use of these bearings has permitted the design of dynamometer shafts of the dimensions and rigidity needed for such high-speed work. To obtain maximum sensitivity and accuracy, the trunnion bearings on which the dynamometer casing oscillates are of the oil lift type which eliminates metallic contact and has practically no friction. The shaft bearing centres are so close and the shaft so stiff, that whirling speeds are displaced well above the normal maximum.

The DA type has one set of power absorbing elements, running in one direction of rotation only. The DAR type has two sets, each arranged to absorb power in opposite directions of rotation, the dynamometer thus becoming directly reversible. The DAD type, which has two sets of elements, each working in the same direction, is non-reversible, but capable of dealing with twice the power of its DA and DAR equivalent. The smallest machine in the new range, fitted with a single rotor element, is known as the DA-190 and will deal with 350 b.h.p. at speeds up to 45,000 r.p.m. By fitting the same size machine with two rotor elements, the power capacity is doubled. Similarly, the largest size, known as the DAD 790, will deal with 13,500 b.h.p. when fitted with a single rotor and 27,000 b.h.p. when fitted with two, at speeds up to 8500 r.p.m. As each dynamometer shaft is rated for four times the single-rotor duty, it is possible to couple two double-rotor (DAD) machines in tandem to absorb as much as 54,000 b.h.p. at 8500 r.p.m.

## Colour Television

THE B.B.C. has issued a report on colour television tests up to the spring of 1957. It describes the results as promising, though further experimental work will be needed to resolve outstanding problems concerning mainly the design of equipment. The B.B.C. has formed the opinion that the system used (an adaptation of the American N.T.S.C. system) is capable of giving acceptable results. The report, B.B.C. Engineering Division Monograph No. 18, *The B.B.C. Colour Television Tests : An Appraisal of Results*, is published at 5s. Since these tests were completed, a further series has been carried out. The results of these are now being analysed.

The B.B.C.'s verdict is that the colour pictures produced by the N.T.S.C. system as adapted to 405 lines, with the picture sources and display tubes that are at present available, are satisfactory. The quality of ordinary black and white television, when received on a colour television set, was found to be generally satisfactory. The problem of registration with the three-tube colour camera requires attention and certain features of the display tube could with advantage be improved, but the technical performance of the system is adequate for a satisfactory colour television service in the frequency bands at present in use. The tests radiated from Crystal Palace from November, 1956, to April, 1957, included live studio performances, film and slides. Of the observers, 89 per cent regarded the reception of the live scenes as satisfactory. The 35mm film was regarded as satisfactory by 100 per cent of the observers, and the 16mm film by 93 per cent, and the slides by 98 per cent. Over 1000 questionnaires completed by B.B.C. staff were analysed to obtain these results.

The results of the tests have been communicated to the television advisory committee, which has the task of advising the Postmaster-General on the whole field of television. The results have also been sent to the C.C.I.R. (International Radio Consultative Committee), which has just met in Moscow to consider colour television. The B.B.C. will carry out further experimental transmissions from time to time. It is pointed out that there are many other problems to be solved : for example, the production of a reasonably priced colour receiving set and agreement on the future standards to be applied to the development of television in the United Kingdom. The decision whether or not there is to be a public service of colour television, and, if so, the system to be used, rests with the Postmaster-General.

We understand that Marconi's supplied much of the transmission equipment which has been used by the B.B.C. in its experimental colour broadcasts, including the three-tube colour cameras, the associated camera control equipment, the complete signal encoding equipment, and all the accessories which go to make a complete colour camera channel, including colour monitors. The manufacturer also reports that Marconi transmitters, including the high-power transmitters at the Crystal Palace, were used for the majority of the experimental broadcasts.

The modified N.T.S.C. system has also been developed by Marconi's for medical use. Last week a vehicle containing over 2 tons of colour television equipment was formally handed over by this company to Smith Kline and French Laboratories, Ltd.; this is claimed to be the first unit of its kind in the country. This equipment will be used to televise surgical operations over a closed circuit at medical conventions.

## Control of Power Stations

IN making his speech on June 11 at the opening of Evershed and Vignoles's new offices at Acton Lane Works, Chiswick, Sir Christopher Hinton, chairman of the C.E.G.B., briefly surveyed the future of automatic control for chemical processes, power stations, &c. " I believe," he said, " that we are not by any means at the end of the potential development of complete process control, but in seeking further applications I do feel it is necessary to have in mind that some of the major problems in achieving those further applications are human and psychological." Sir Christopher went on to say that he was quite certain that, technically, there would be no difficulty within the next few years in putting chemical and other process plants under centralised control, such that the plant could be looked after virtually by one man. He believed that, again technically, it would be reasonable to contemplate a time when all power stations could be operated from a central point. One had to remember, however, that automatic controls to-day and, he thought, for a long time in the future, would look after plant when it was operating normally, or within certain limits of departure from normality, but that in abnormal circumstances a skilled man was still needed. The problem, as Sir Christopher saw it, was not so much a technical one ; it was rather a problem of whether and to what extent it was economical, and how, when it became economical, the managers of a plant were to be kept mentally alive during 99 per cent of the time in order that they might be alert for the remaining 1 per cent of the time when conditions went beyond the controls.

## Aluminium in Packaging

A SYMPOSIUM on aluminium in packaging, sponsored by The Aluminium Development Association, was held on Thursday, June 12, in the Savoy Hotel, London, with Mr. S. E. Clotworthy, the president of the Association, as chairman. The meeting was attended by a large number of representatives of all sections of the packaging industry and they were the guests of the Association at lunch, at which the guest of honour was Mr. W. J. Taylor, Parliamentary Secretary to the Ministry of Supply.

Eight papers were presented for discussion, of which three were the subject of the morning session, the remainder being discussed in the afternoon. Mr. D. C. G. Lees, M.A., was the rapporteur for the morning session and summarised the main points arising from the first, second and third papers, which were entitled : " The Characteristics of Aluminium of Importance in Packaging," by E. E. Spillett, B.Sc., and E. Elliott ; " The Case for Aluminium in Packaging," by J. C. Bailey, B.Sc., and " The Design of Aluminium Packs," by Milner Gray. Paper No. 1 noted that 30,000 tons of aluminium was used by the industry in 1957 and summarised the characteristics of the metal with particular reference to its impermeability, lightness and resistance to attack. To these properties was added the fact that aluminium is hygienic, non-toxic, without odour or taste, and that it is suitable for contact with food. The second paper was mainly concerned with the increased use of the metal for packaging as influenced by economic considerations. Tables indicated the growth in the tonnage used and the *per capita* consumption in a number of countries and the paper considered the position with regard to collapsible tubes and rigid containers, together with a scheme for reducing costs. High scrap value was put forward as a pointer towards cost reduction provided there was a workable container recovery system. In paper No. 3 the basic problems of the designer were considered from the point of view of the appeal to the customer.

The papers at the afternoon session were reviewed by Dr. E. G. West, B.Sc. ; they were : " Aluminium Cases for Processed Food," by A. V. Lovell, B.Sc. ; " General Line Containers," by R. Taggart ; " Aluminium Collapsible Tubes for Packaging," by R. W. D. Carr, M.A. ; " Aluminium Foil in Packaging (Production, Conversion and Uses of Foil and Foil Laminates)," by T. H. Angel, Ph.D., and J. R. Green ; and " Aluminium Closures," by W. R. Gamble, B.Sc. The first paper of the afternoon presented a review of aluminium cans for processed food in which present applications were surveyed and factors influencing design were discussed. Methods of manufacture and typical plant were illustrated and the results of shelf life and storage tests recorded. In the next paper, the use of aluminium for built-up, shallow-formed and deep drawn and impact-extruded containers was considered, and the latter was compared with regard to price, weight and volume with glass. The advantages of the extruded aluminium pressurised containers were set forth and the point made that there are no technical problems in the uses of aluminium for the containers. The third paper of the afternoon discussed the materials used for collapsible tubes, the principle of the extrusion production process, the method of decoration and recent developments. The following paper, the seventh of the meeting, dealt with production of foil and its characteristics and methods of sealing, and then considered the combination of foil with plastic film or paper to form a laminate. The purposes served by the application of coatings to aluminium foil were listed and an appendix gave data concerning moisture resistance, opacity and penetration by insects. Design and production of closures were reviewed in the last paper, which noted the materials used and illustrated the manufacturing processes.

A small exhibition illustrated the properties of the material and individual sections contained examples of foils and foil laminates, can-making methods, collapsible tubes, general line containers and recent developments, including items from abroad.

## Nuclear Agreements with Japan

SEPARATE agreements have been concluded between the U.K. and Japan and between the U.S.A. and Japan to cover a decade's collaboration in peaceful nuclear power projects. We understand that competitive tenders from three of the British nuclear power consortia, each for a station with an output in the order of 140MW, are being considered by the Japanese authorities; they are now satisfied that the risk from seismic shocks can be reduced to an acceptable level. It is reported that an American design (possibly subsidised) will also be purchased.

Information not classified in one of the grades of secrecy will be passed on, and the U.K. Atomic Energy Authority may help to build plant in Japan for making and processing fuel elements. It has been agreed that fissile material recovered by the Japanese will not be used for military explosives, and that the U.K.A.E.A. will have first call on any surplus. The U.S.A., in its turn, has agreed to provide 2700 kg of $U^{235}$ over the course of the decade.

## Haul-Off Equipment for Cable-Making Machines

Two new machines have been developed by Larmuth and Bulmer, Ltd., Union Street, Salford, for use in the wire rope and cable-making industries. One of these machines, a "caterpillar" haul-off, illustrated below, is designed for use in connection with a cable-making machine where excessive strain on a cable as it is hauled off is likely to damage the sheathing. In this machine, the cable is gripped between two "caterpillar" belts, each of which has a steel core carrying special rubber shoes. These shoes are notched to form a series of jaws which impart a firm grip along the length of cable. Each caterpillar belt is supported through a number of rollers in a frame which can be adjusted to permit the handling of cables of different diameters.

A positive grip is imparted on the length of cable between the jaws by hydraulic loading cylinders, and the pressures which can be preselected range up to 7000 lb per square inch. The required gripping load is controlled by a lever on the instrument panel which also carries a gauge which indicates the pressures at which the machine is operating. The pressure of the jaws is relieved by a return spring when it is required to release the cable. The stable nature of the caterpillar assembly enables the machine to be used as an independent cable measuring device and an indicator is provided on the instrument panel for this purpose.

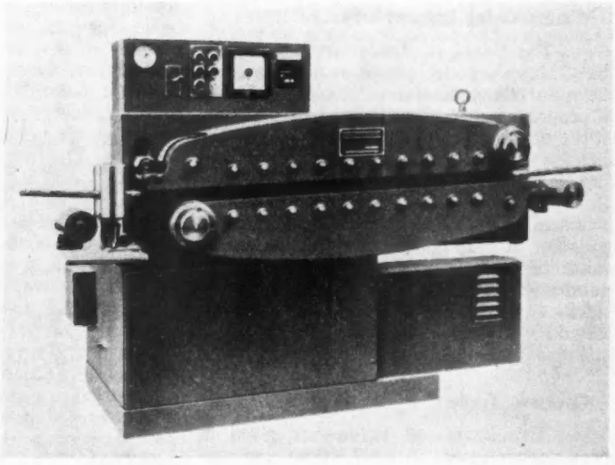
The driving of the caterpillars can be through a P.I.V. variable-speed box, which receives its power either from a constant-speed motor or by a direct transmission from the cable-making machine.

One of the two types of haul-off machines available is suitable for cable diameters between 0·20in and 2·30in, and exerts a pull up to a maximum of 1000 lb at speeds between 7ft and 190ft a minute. The second is suitable for cables between 1in and 4in, and pulls up to 3000 lb at speeds between 7ft and 130ft a minute.

A new independent take-up drum stand also being made by the firm can be operated independently of the machine it serves. These machines are mounted on a rigid steel chassis and they can be moved around as required to serve a number of machines according to the necessities of manufacture. These stands are made in six different sizes, covering drums with external rim diameters from 29in up to 118in diameter. A drum is supported on this design of stand by a through shaft, and for quick and easy movement, raising and lowering is effected by hydraulic jacks.

Where a stand is required for a wide range of operation the winding gear is driven by a motor which has a wound rotor with a slip characteristic when operated against a cable pull beyond a preset tension. By the use of a variable torque control, a required cable tension may be chosen from a calibrated dial before starting up, or it can be simply adjusted during running by operating a control handwheel. When the production machine stops the driving motor slips, but maintains a constant pull on the cable. There is no risk of damage to the motor under these conditions as it is cooled by an auxiliary fan.

For cables of $\frac{1}{2}$in diameter and over, using cable pulls below 200 lb, the traverse winding gear is fitted with an automatic device by which a guide shoe places each coil in the correct position by the action of a "feeler," which is guided by the preceding coil. When used for cables below $\frac{1}{2}$in diameter, the unit is fitted with the conventional device with pawls and ratchet wheel.



Caterpillar haul-off machine for cable-making plant

## Second Geneva Conference on Atomic Energy

FORTY-FIVE governments and four intergovernmental agencies have so far submitted 2370 abstracts of papers for the second United Nations conference on the peaceful uses of atomic energy, which is due to be held in Geneva in September. There are more than twice as many papers as were offered for the first conference in 1955. A new subject for the conference is that of controlled thermonuclear fusion. Nearly a hundred abstracts on fusion experiments or studies have been sent in by a dozen governments. Fission is still not old-fashioned, however, and the conference will review experience with reactors that are now producing power in a number of countries. The role of nuclear power in their economies is to be outlined not only by the leading nations, but also by such countries as India, Italy, Japan, Rumania and Sweden.

The problems of producing and processing fuel for fission reactors will be examined in a number of papers. More attention is being paid than in the first conference to ways of separating $U^{235}$ from natural uranium, and more stress is being placed on the chemical processing of fuel elements that have been partly consumed. An American contribution will discuss a pyrometallurgical process by which to purify molten fuel, and for which a plant is being built. The manifold uses of radioisotopes will once again form a dominant subject for review at the conference: 120 abstracts deal with medical applications, and, to illustrate the parallelism of much of the effort, seventeen separate countries have reported on the use of $I^{131}$ for the diagnosis or therapy of thyroid disorders. There are about ninety papers on radioactive tracers for the study of fertilisers, soil characteristics and diseases in livestock. A number of papers indicates the increasing adoption of radioisotopes in measuring devices and controllers, and also their use in modifying the properties of certain materials. Abstracts have been received of papers on the nuclear-powered ice-breaker recently launched in Russia, the American merchant ship "Savannah" which is now being built, and Japanese studies for a submarine tanker.

Developments in fundamental physics will, of course, also be reviewed at the conference.

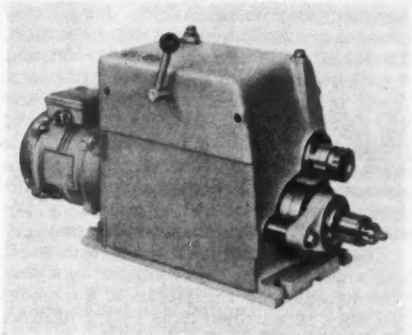
## Coil Spring Research

AT the recent annual conference of the Coil Spring Federation, the president, Mr. R. Salter Bache, appealed for more support for the coil spring industry's research organisation. Collaboration in the industry had become more important, he said, because of increased competition, rather than in spite of it. The importance of the development of materials, processes and techniques in spring production, Mr. Bache remarked, was not only a matter of interest to spring manufacturers but also to all users of springs. As springs were of such importance to all branches of the engineering industry, it was in the interests of all users to take an active part in research to improve spring performance.

The Coil Spring Federation was established in 1942 and its research organisation was formed three years later. The research organisation's work is assisted by a grant from the Department of Scientific and Industrial Research, and a report has just been published on the progress made during 1957. Laboratory accommodation for the Coil Spring Federation is provided by the British Iron and Steel Research Association.

## Drill Unit

A DRILL head unit now being made by Stuart Davis, Ltd., Much Park Street, Coventry, has a chuck capacity for $\frac{1}{16}$in drills in steel and a spindle travel adjustable up to 1$\frac{1}{4}$in, the maximum feed travel being 1$\frac{1}{2}$in. The spindle is driven by a $\frac{1}{4}$ h.p. motor and the unit is available with two types of drive. A flange-mounted motor can be fitted, giving three alternative speeds of 700, 1400 or 3000 r.p.m., and an alternative vee belt drive when used gives spindle speeds of 1100 to 3000 r.p.m., with a 3000 r.p.m. motor, or 250 to 2000 r.p.m. with a 700 r.p.m. motor.



Drill unit for $\frac{1}{16}$in drills. An air-hydraulic feed gives steplessly variable drilling feeds and rapid approach and return strokes

An air-hydraulic system is used for actuating the drill feed motion and the lever to be seen on the side of the unit in the illustration controls the in-and-out spindle movements. A graduated knurled knob above the spindle nose controls steplessly variable feed rates. The length of the rapid approach stroke and the total depth of the feed stroke are controlled by adjustable stops and the rate of power feed is independent of spindle speeds.

# Industrial and Labour Notes

### Iron and Steel

British steel production in May averaged 379,000 tons a week, compared with 407,800 tons in April. The Iron and Steel Board says that the Whitsun holiday and a reduction of producers' stocks of crude steel during May contributed to the fall in output. Furthermore, production continued to be affected by the lower export demand and the reduced home demand which was particularly noticeable in the building and allied trades. Pig iron production in May was at the rate of 249,600 tons a week compared with 256,900 tons a week in April. The Board adds that the consumption of finished steel in the United Kingdom in the first quarter of this year was just over 3,500,000 tons, or 0·8 per cent more than in the comparable period of last year. The increase, it is suggested, was due to the substantial rise in motor vehicle output which offset the decline in steel consumption in other industries.

Last Monday, in Parliament, the Paymaster-General was asked if he would make a statement on "the present recession in the iron and steel industry," and what action the Government proposed to take. The reply was made by the Parliamentary Secretary to the Ministry of Power, Sir Ian Horobin, who said that, as the demand for certain steel products had declined, the industry was now temporarily working under capacity in certain sections. No Government action would be justified, however, at this stage to deal with this fluctuation in trade. The most recent figures, Sir Ian added, though admittedly only up to the end of March, showed that home steel consumption this year was actually rather higher than last year. What had happened was a "very great fall in exports." That should drive home to all concerned the necessity for competition.

### Welsh Steel and Tinplate Industry

At the beginning of February, the Minister for Welsh Affairs, Mr. Henry Brooke, in consultation with other Ministers, appointed a Government team to examine "further methods of meeting the difficulties raised by the closure of certain steel sheet and tinplate works in West South Wales and the threatened closure of further works." The team was not asked to consider the problems concerned with the building of a new integrated steel works and strip mill as this subject was already under consideration.

The team's report has now been received, and some of the matters contained in it were communicated to the House of Commons last week in a written reply by the Minister for Welsh Affairs. This reply says that the team reviewed the recent history of the tinplate and sheet industry and emphasised that what it had examined was essentially "the remainder of the industry after the technical revolution represented by the erection of the fundamentally different integrated plants at Ebbw Vale, Margam, Trostre and Velindre." The team concluded that there was virtually no prospect of any further work for the hand tinplate mills, which had mostly closed already. At some of the hand sheet works, operations were still continuing and might go on till the end of 1959. But the scale of operations during that period would depend very much on general economic circumstances. At the end of 1959, extensions to the modern plants producing sheet would come into operation, which would inevitably mean little or no demand thereafter for the product of the hand sheet mills.

The Minister's reply went on to emphasise the team's view that there had been a complete revolution in the tinplate industry. West South Wales, it was pointed out, now had two of the most modern tinplate plants in the world and the output of tinplate was greater in the area than it had ever been before, though fewer people were employed and the manning of the modern plants was almost complete. The revolution in the sheet industry had not yet gone quite so far, but before long most of the old plants would be replaced by the modern plants in other parts of Wales. So far as the old steel works were concerned, the team considered that further contraction was almost inevitable. It believed that the improvements taking place at a few of the plants had a good chance of success and should be given such encouragement as lay in the Government's power. It did not consider that there was anything the Government could or should do to try to keep the other old plants going, since that would increase the risk that all would ultimately fail. The team accordingly recommended that the future of the area must lie in the development of a wider variety of industries there.

### Manufacturing Industry's Stocks

The Board of Trade has announced that, according to provisional estimates, the value of manufacturers' stocks and work in progress increased by less than 1 per cent in the first quarter of this year. This small increase followed a slight decrease in the fourth quarter of 1957. This year's first quarter estimates, it is stated, indicate increases in the value of both work in progress and finished goods but a decrease in the value of materials and fuel. The index number (December, 1955=100) of value of stocks and work in progress was 118·9 at the end of March. At the corresponding date last year it was 114·5.

### Overseas Trade

The Board of Trade has given a provisional figure of £287,300,000 as the value of United Kingdom exports in May. This is £22,000,000 higher than the April total and is, in fact, the best figure recorded since May last year. But in the first five months of this year, exports were 2 per cent lower in value than the total achieved in the corresponding period of last year. Imports in May have been provisionally valued at £308,600,000, which is £2,000,000 below the April figure. The May figure, the Board of Trade says, was affected probably to the extent of £10,000,000 to £15,000,000 by the London dock strike. In the first five months of this year imports were 13 per cent lower in value than in the comparable period of 1957.

### Strike Ballots

During the London bus and dock strikes there has been a good deal of discussion about the desirability of a secret ballot by trade union members to determine strike action. The matter was raised again in the House of Commons last week by Mr. Gresham Cooke. He asked the Minister of Labour to invite the Trades Union Congress to recommend to trade unions generally that their rule books should be modified so that strike action and its discontinuance be determined by a secret ballot of members.

The Minister, Mr. Iain Macleod, said in his reply that he realised that there was "a considerable body of opinion" which supported Mr. Cooke's view. But from what study he, the Minister, had given to the matter, he did not believe that a secret ballot would in any way reduce the incidence of strikes. In particular, it would have practically no impact upon the unofficial strikes which were the present main difficulty.

### Employers and Workers

In his chairman's speech at the annual meeting of The Industrial and General Trust, Ltd., on June 12, Sir Edwin Herbert referred to the "tremendous social revolution" through which this country had been passing since the war. It was not surprising, he said, if the labour unrest, which naturally accompanied that revolution, broke out from time to time in the form of strikes, either official or unofficial. It was regrettable, of course, and sometimes it might seem quite unnecessary, but, Sir Edwin remarked, it was well to remember that there were few countries where such great changes could have been effected so peaceably. If one viewed dispassionately what this country had accomplished in the years since the war, one could look back with pride and forward with hope.

Sir Edwin went on to suggest that there was still far too much loose talk of the difference between employers and workers as though their objectives were completely at variance. This, he thought, was quite wrong; basically both had the same objective but differed in their view of the steps which should be taken to attain it. Although much remained to be done in reconciling the two points of view, it was fair to say, Sir Edwin asserted, that employers and employed were closer together to-day, in most sections of industry, than they had ever been before. Employer and employed alike worked within limits of stern economic necessity. There was, he believed, a growing willingness to recognise facts and it was only from a realistic position such as that that future prosperity could grow.

### Tax Reliefs for Industry

The Chancellor of the Exchequer, Mr. Heathcoat Amory, announced some further tax reliefs for industry on Tuesday, during the committee stage of the Finance Bill. It will be recalled that in his Budget statement in April, the Chancellor said that the initial allowances for depreciation would become 25 per cent for plant and machinery and 12½ per cent for industrial building. Now the rates are to be 30 per cent for plant and machinery and 15 per cent for buildings. The special rate of 40 per cent for mining works remains unchanged. These newly-announced rates date from April 15, when the Budget was presented. In his statement on Tuesday, the Chancellor said it was desirable that plans for investment in industry should continue to be made with confidence. Weighing the various factors, he had come to the conclusion that it would be well now to make some increase in the practical encouragement he sought to give industrial investment by improving the initial allowances.

# West German Brown Coal

No. III—(*Continued from page* 908, *June* 13)

*A substantial proportion of the German Federal Republic's electricity, and large amounts of domestic and industrial fuel, are derived from lignites, the largest deposits of which are found in the Rhineland west of Cologne. The present article reviews the development of this coalfield which, since the war, has undergone an unprecedented expansion. Since we published an article on this subject ten years ago,* deep opencast mining, the feasibility of which was then still under debate, has made rapid strides through the introduction of extra-heavy machinery.*

NEXT in importance to its use for the generation of electricity is the employment of brown coal for domestic and industrial heating. At one time the railways also consumed large amounts of brown coal, but the number of steam locomotives is constantly being reduced in the course of an extensive programme of electrification and dieselisation.

### Briquetting

If brown coal is to be used in places which are at great distances from the mine, it is essential to remove most of the water to be found in the crude coal in order to reduce transport charges. At the same time, it is necessary to process the coal into a product which will be convenient for handling. This is done by briquetting, a process which in a primitive form—wetting and working a mass of soft brown coal and drying it in moulds—was already practised in the late eighteenth century. Since large lumps of wet brown coal do not dry satisfactorily, while pre-dried small coal cannot be moulded by hand, further progress depended upon the possibility of applying much greater pressure. The first suitable press for this purpose was invented by Exter in 1857. Pressures of the order of 1000 atmospheres are applied which compress the material as well as moulding it.

After screening the raw brown coal to remove fines, sizes of 10mm and over are passed through hammer mills and subsequently rescreened. The fines are dried in rotating drums, while the large particles are recycled or sold separately. The drying drums are cylindrical shells of about 4m diameter, revolving at 6 to 8 r.p.m. about an axis slightly inclined to the horizontal, and fitted inside with axially arranged pipes of 100mm diameter, which are surrounded by slightly superheated steam. Wet coal is fed in from one end by means of a hopper and passes through the dryer in ten to twenty minutes. Drying is assisted by drawing warm air through the pipes. Emerging with a temperature of 80 deg. to 85 deg. Cent., the coal is exposed to a further airstream which removes interstitial water vapour, which would hinder the moulding and which also cools it to 50 deg. to 60 deg. Cent. It is, however, becoming clear that it is the final drying and not the cooling which is important, so that nowadays this last drying process is usually combined with a further grinding and screening stage, the intermediate cooling being omitted.

During drying, there occurs an ageing of the grain surfaces which results in hardening and a decreased readiness to reabsorb moisture. At the same time, the moulding properties and strength of the briquettes are reduced, as there is not sufficient water on the grain surfaces to act as a lubricant so that the coal particles could be pushed into sufficiently close contact. This is the reason for having a grinding stage, after the drying, which supplies the required moisture by exposing the moist centres of the particles. Such briquettes also show a more even shrinkage during combustion and retain their shape longer in the fire.

Briquetting presses are plunger presses in which the plunger, which sits on the extension of a crosshead, is driven by means of a heavy flywheel, eccentric and connecting-rod. Coal is filled into a hopper situated at the side of the mould which is towards the flywheel. The plunger passes through the hopper on its outward stroke and injects a quantity of coal into the convergent-divergent extrusion mould. By making the mould in two halves and housing the top half in a hinged frame, the angle of convergence can be adjusted by means of a screw spindle stop, or hydraulically, to suit the grade of coal which is being briquetted. The mould is held in the machine by safety straps which break under overload and so allow the mould to be ejected, thereby saving possible damage to the press. Below are shown two briquetting presses made by Klöckner-Humboldt-Deutz A.G., during assembly.

### Excavating Machinery

Modern opencast brown coal mining is machine intensive and characterised by the development of a range of earth and coal excavating and transporting equipment, all of which is very large and some of which is unique for size and performance.

The basic tool, without which opencast mining on the present scale would be unthinkable, is the mechanical excavator in its various forms. The bucket chain excavator, originally developed in France and employed on railway and canal construction, was further developed in Germany by Lübecker Maschinenbaugesellschaft (LMG), who in 1891 introduced the first excavator—a steam-driven, high-cutting machine—in the Rhenish mine Gewerkschaft Brühl. Three years later this firm projected a second kind of equipment which has since become of great importance, the conveyor bridge for spoil. Electric motive power was applied for the first time in 1898. The early machines were mounted on rail tracks, and some very large ones were supplied to the Middle German mines, where there was a large thickness of overburden. Thus, the largest excavator at the time, an LMG bucket excavator, cutting to 40m below track level and removing 750 cubic metres per hour, was commissioned at the mine "Ilse" in 1909. Already before the first world war an endless chain coal scraper had been introduced whose downward cutting boom could reach to 30m to 36m above track level. The seam was scraped down at angles of 60 deg. to 75 deg. and the coal taken up by means of a short bucket chain.

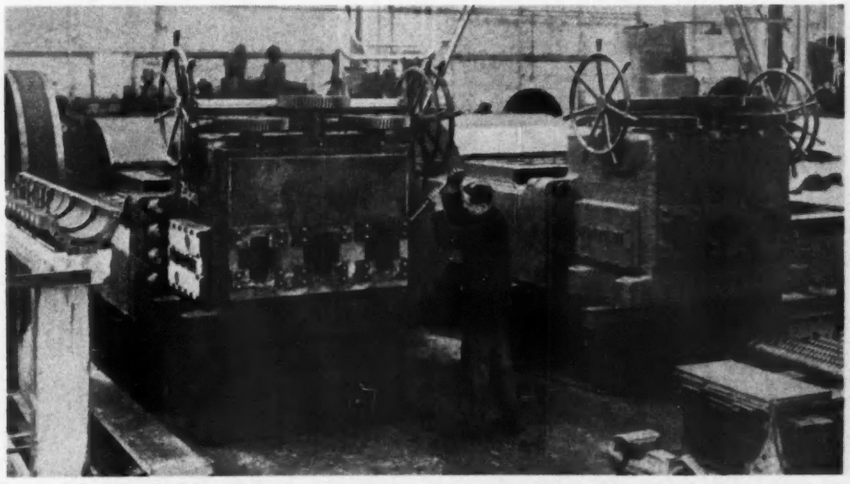
The invention of the belt conveyor with cotton-reinforced rubber belts, due to A. M. Clark (1883), was first used by the Compagnie Nationale des Travaux Publics, of Paris, although it is stated that Clouth in Cologne was already making rubber conveyor belts *ca.* 1870. Probably because the feeding arrangements were not yet sufficiently developed, it was considered for a long time that belt conveyors were unsuitable for any except sandy soils. For harder soils use was made of plate or bucket conveyors. An exception was the above-mentioned LMG conveyor bridge project of 1894, which incorporated a belt conveyor some thirty years before the general introduction of such conveyors. The same idea was carried into effect in 1897 in the Ludowici clay pit, where an LMG cantilever conveyor of 35m span was combined with a bucket chain excavator. The arrangement of 1894 and the realisation of 1897, incidentally, are claimed to mark the beginning of modern continuous strip mining.

It will be seen from the foregoing remarks that most kinds of mechanical equipment used in brown coal mining can look back on a history of many decades. Of more recent development are the use of track-mounted equipment and the introduction of the rotary excavator. Tracked fighting vehicles made their first appearance on the Somme in 1916. Later, track-mounted excavators were built on the German side for digging military trenches. From this invention stemmed the first tracked LMG bucket chain excavator for opencast mining which was commissioned in 1919 in the Prinzessin Viktoria mine in Neurath. In 1926, the same firm supplied a three-point supported machine with two steerable tracks, to the "Vereinigte Ville" mine, the success of which paved the way for the later large-scale versions of this design.

The invention of the bucket wheel as an excavating tool was patented in 1913, but it was only in 1920 that the first rotary bucket excavator was put into service in a Middle German brown coal mine. This machine, however, was a failure, and for many years rotary excavators could not make any headway against the highly developed bucket chain design. Their practical application in coal mining thus dates effectively from the middle 'thirties.

Rotary bucket excavators for coal mining were built by LMG from 1935 onwards. In 1955, this firm, amalgamated with Orenstein-Koppel A.G. (O. & K.) since 1950, supplied the first of three track-mounted giant excavators, with a service weight of 5900 tons, a working height of 50m and an hourly capacity of 10,800 cubic metres.†

The second of the three bucket excavators has since been commissioned and the third is to go into service this year. Two machines of similar size and capacity were ordered from Fried.



**Triple-ram briquetting press during assembly, showing the die retaining straps each held by four bolts designed to break under overload. The taper of the half-dies can be set by means of the large handwheels**

* "Opencast Mining in the Rhine Brown Coalfield," by W. L. G. Muir, THE ENGINEER, April 9, 1948, page 344; April 16, page 368, and April 23, page 392.

† See also THE ENGINEER, January 6, 1956, page 29.

**Large LMG rotary bucket excavator, for an hourly output of 10,800 cubic metres. The machine is connected by a conveyor bridge to a track-mounted loading unit. A similiar excavator can be seen in the background**

Krupp Maschinen- und Stahlbau Rheinhausen, one of which has gone into service.

TABLE VII—*Large LMG Rotary Bucket Excavators*

| Completion ... ... ... | 1957 | 1955 |
|---|---|---|
| Maximum difference in track level between excavator and loader | ±10m | ±5m |
| Maximum cutting height above excavator track | +50m | +50m |
| Maximum cutting height below excavator track | −20m | −10m |
| Total operating range from loader track | +60m<br>−30m | +55m<br>−15m |
| Cutting height range ... | 90m | 70m |
| Output, cubic metres per hour | 10,800 | 10,800 |
| Maximum length, approximately | 190m | 192m |
| Maximum height above track, approximately | 66m | 66m |
| Length of conveyor bridge | 70m to 88m | 67m to 80m |
| Belt width... ... ... ... | 2·6m | 2·6m |
| Total weight ... ... ... | 5,820 tonnes | 5,910 tonnes |
| Counterweight ... ... | 320 tonnes | 461 tonnes |
| Total track area ... ... | 430 square metres | 456 square metres |
| No. of motors ... ... | 118 | 116 |
| Installed capacity ... ... | 7,780kW | 7,380kW |
| Motor-generator sets (No. of machines and their capacity) | 10 (25 with 5,240kW) | 11 (36 with 6,584kW) |
| Supply voltage (cable) ... | 25kV, 50 c/s | 25kV, 50 c/s |
| Motor voltages ... ... | 3,000/500/220 | 3,000/500/220 |

### LARGE ROTARY BUCKET EXCAVATORS

The second of three large LMG excavators, which was completed last year, is shown above. It will be seen that it consists of two principal portions, the excavator itself, and the loader which is connected with the excavator by a conveyor bridge. The overall span of the assembly, from the centre of the excavator wheel to the centre of the farther of the two rail tracks served by the loader, is about 178m. This distance can, however, be decreased to about 160m by sliding the conveyor bridge into the central portion of the excavator. The centre of the excavator can rotate independently of the undercarriage as well as the superstructure, with which it is connected by two large centreless slewing rims of 15m diameter. The arrangement ensures maximum flexibility of the equipment. Table VII gives the principal data, for purposes of comparison together with those of the first machine which was commissioned in 1955.

It will be seen that compared with the 1955 machine, the operating range has been increased, although the overall weight is somewhat less. The increased horizontal range was obtained by lengthening the intermediate conveyor, while greater cutting depth was made possible by the use of a steep angle conveyor equipped with top and bottom belts. An important step was also the introduction of a cell-less excavator wheel. This was necessitated by the fact that the sense of rotation of the wheel must be reversed when changing from high level to low level operation. While the buckets can be made reversible, this is not possible with the cells, a difficulty which is circumvented by using a wheel without cells which, in addition, is more suitable for the heavy soils which are frequently encountered. By contrast with the cell wheel, the axis of which is at right angles to the boom, the cell-less wheel is set at a lesser angle, so as to give access to a short, intermediate belt conveyor. This arrangement also gives a better cutting angle and makes it possible to dispense with a separate feed for the boom; this in turn results in a substantial saving in weight.

In describing the cutting wheel of the 1957 machine, the data for the earlier excavator are shown in brackets. The wheel diameter is 16·5m (16m) and there are ten (twelve) buckets, each holding 1800 litres (3600 litres). However, the cell-less wheel operates at nearly twice the speed of the former, 4·32 r.p.m. compared with 2·23 r.p.m., giving a circumferential speed of 3·73m per second, as compared with 1·9m per second. It is driven through gearing by two 550kW (525kW) motors. Its weight is only 88 per cent of the former design.

The 1957 excavator comprises nine main conveyors and five conveyors for the removal of dirt falling off the underside of the main conveyors. Most main belts are 2·6m wide except the first conveyor which extracts the material from the wheel and which is 2·4m wide. The covering (top) belt of the steep angle conveyor, like the dirt conveyors, has a width of 2·8m. Total installed capacity for the main conveyors is 3400kW, and for the ancillary dirt conveyors about 100kW.

A brief note may be added here regarding the steep angle conveyor. This is mounted in the boom and enables it to cut below track level at up to 40 deg., about twice the angle which is possible with an ordinary conveyor. As has been indicated, this kind of conveyor embodies two belts, one carrying the excavated material, and the other covering it so as to prevent it from slipping. To assist in this function, the belt is weighted by specially mounted rollers ; it can be lifted clear when high cutting is carried out.

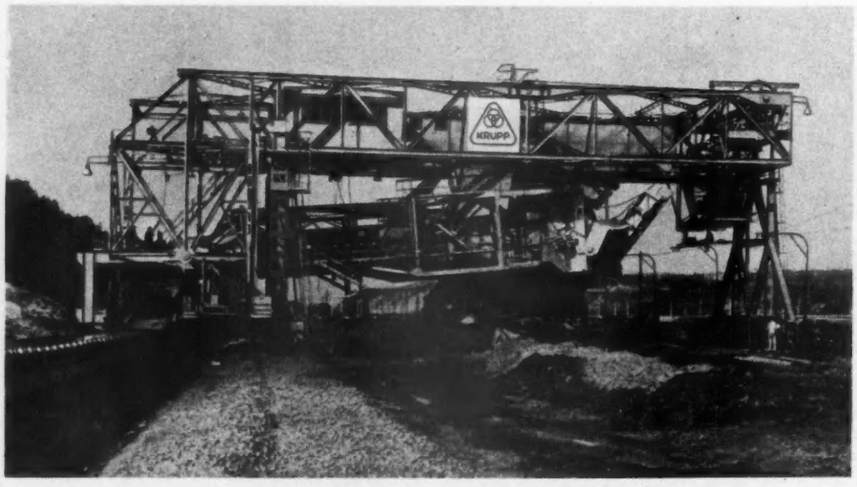
The excavator is supported on three groups of four endless tracks, each 2m wide, giving a normal mean pressure of 1·3 kg per square centimetre, or 1·75 kg per square centimetre under the worst possible load conditions.

Cutting is carried out in a manner designed to minimise the movements required of excavator and loader. The machine cuts out a block 90m wide along the whole length of the face of the mine. Cuts are taken at the different levels by means of a slewing movement of the boom, the machine advancing between cuts so as to form a slope with an average gradient of 36 deg. Each cut is about 10m high and can be carried out under full programme control.

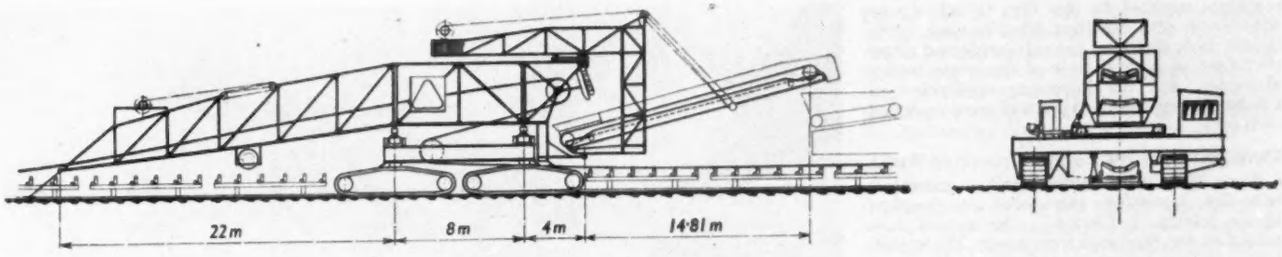
### LOADING, TRIPPING AND SPREADING EQUIPMENT

As an example of other large-scale equipment employed in the Rhenish coalmines we shall describe an installation completed last year by Fried. Krupp Maschinen- und Stahlbau Rheinhausen. The installation is for the purpose of spreading the overburden brought by rail from the excavation. It comprises a bucket wheel loader, which takes up the spoil tipped by the wagons and loads it to a belt conveyor, from where the crawler-mounted tripper transfers it to the conveyor of the spreader. The capacity is 8500 cubic metres per hour.

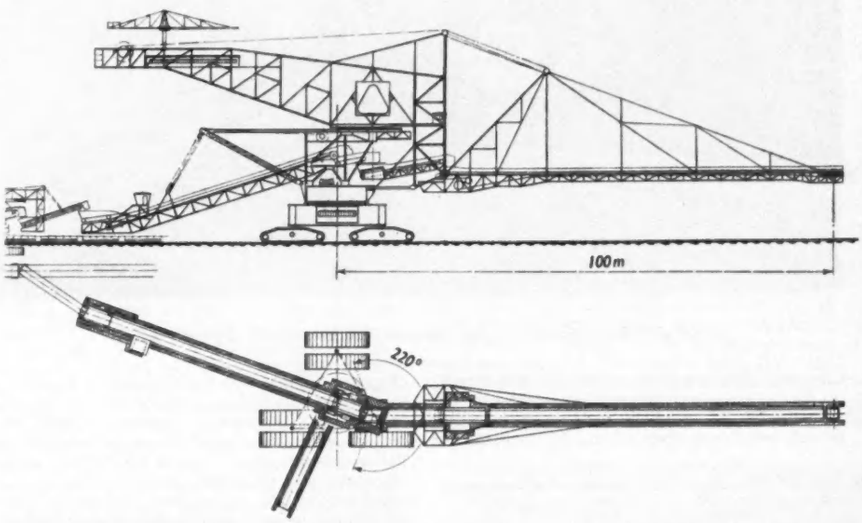
Below is shown the loader, which consists of a rail-mounted travelling portal frame, each leg running on standard gauge track set at a distance of 28m between centres. On one side the bridge spans the railway track. On the opposite side it extends downwards into a bracket on which is hinged the jib carrying the bucket wheel and on which are also mounted supporting rollers for the conveyor belt at a centre distance of 6·4m from the near track. The conveyor belt is lifted off its supporting rollers and threaded over the rollers of the machine. The 12·5m diameter bucket wheel is at the centre of the bridge span and its jib can be raised or lowered by wire ropes. With a trench depth of 6m, the volume per metre of travel is 17·5 cubic metres. The cell-less wheel is equipped with eight 3·5 cubic metre buckets. These discharge on to a roller grid which removes




**Loading bucket wheel for taking up overburden dumped by railway wagons and transferring it to belt conveyor which takes it to the spreader. The rail-mounted machine has eight buckets each of 3·5 cubic metres capacity**




**Crawler-mounted tripper**




**Crawler-mounted belt spreader for dumping above and below track level. Hourly output is 8500 cubic metres, length of dumping boom 100m, dumping height above track level 34m**

TABLE VIII—*Recent Krupp Spreaders in Rhenisch Brown Coal Mines*

| Model | As $\frac{500}{42}$.16 | As $\frac{850}{42{\cdot}5}$.16 | As $\frac{1200}{60}$.21 | As $\frac{2000}{70}$.25 | A2s $\frac{4500}{90}$.25 | Aus 3500 ·6 AR(B) $\frac{2-2\cdot4}{8500}$.35 BR 15+34·5 |
|---|---|---|---|---|---|---|
| Number built | 3 | 1 | 3 | 3 | 1 | 1 |
| Commissioned | 1956 | 1951 | 1955 | 1955 | 1955 | 1957 |
| Bucket volume, litres | 500 | 850 | 1200 | 2000 | 4500 | 3500 |
| Wheel diameter, metres | — | — | — | — | — | 12·5 |
| Excavating depth, metres | 2·0 | 3·05 | 2·9 | 4·2 | 5·5 | 6·0 |
| Filling section, cubic metres per metre | 2·6 | 5·3 | 5·3 | 7·1 | 17·5 | 17·5 |
| Output, cubic metres per hour | 1110 | 1500 | 1800 | 2640 | 8500 | 8500 |
| Maximum discharge height, metres | 16 | 16 | 21 | 25 | 34 | 35 |
| Length of spreader boom, metres | 42 | 42·5 | 60 | 70 | 91·2 | 100 |
| Length of charging conveyor, metres | — | — | — | — | — | 51 |
| Length of discharge boom of tripper, metres | — | — | — | — | — | 15 |
| Belt widths, metres | 1·3—1·2 | 1·2 | 1·8—1·6 | 2·5—2·2 | 2·5—2·2 | 2·4—2·0 |
| Number of caterpillar tracks of spreader | — | — | — | — | — | 6 |
| Number of caterpillar tracks of tripper | — | — | — | — | — | 3 |
| Number of wheels under loader | 40 | 40 | 32 | 48 | 64 | 24 |
| Number of wheels under spreader | | | 64 | 96 | 128 | — |
| Installed capacity, kW | 670 | 900 | 1700 | 3000 | 6700 | 6000 |
| Total weight, tonnes | 440 | 445 | 1050 | 2500 | 3000 | 3400 |

TABLE X—*Recent Krupp Bucket Chain Excavators*

| Model | Rs $\frac{250}{8-10}$.8 | Rs $\frac{600}{12-15}$.13 | D $\frac{600}{40-42}$ |
|---|---|---|---|
| Number built | 1 | 1 | 3 |
| Commissioned | 1950 | 1951 | 1955 |
| Bucket volume, litres | 250 | 600 | 600 |
| Output capacity, cubic metres per hour | 525 | 1000 | 1100 |
| Maximum excavating height, metres | 8 | 13 | — |
| Maximum excavating depth, metres | 10 | 15 | 42 |
| Discharge boom length, metres | 25 | 25 | 12 |
| Conveyor belt width, metres | 1·2—1·0 | 1·6—1·2 | 1·4—1·2 |
| Number of caterpillar tracks | 3 | 6 | — |
| Number of supporting wheels | — | — | 48 |
| Installed capacity, kW | 400 | 800 | 600 |
| Total weight, tonnes | 360 | 1200 | 600 |

the material from the wheel and deposits it on an intermediate conveyor on the jib, which in turn loads the main conveyor. In the tripper (top) the conveyor belt is again taken up and looped over two rollers so that a rising section is formed which allows the overburden to be transferred, by way of a slewing intermediate conveyor, to the conveyor of the spreader (left). Whereas other recent Krupp spreaders for the Rhenish mines were all rail mounted, the present machine is carried on caterpillar tracks, of which it has six, arranged in three groups of two. The spreader is fitted with a 51m long feeder conveyor and a 100m long slewing boom which can be raised to a height of 35m. The whole installation weighs 3400 tonnes and has an installed capacity of 6000kW.

### SLEWING SPREADER

An earlier (1955) machine by the same firm for taking up dumped overburden and spreading it, is shown on the next page. This also has a capacity of 8500 cubic metres per hour, but is less flexible in that the rail-mounted loading unit and spreader are rigidly connected by a conveyor bridge. The loader is equipped with a bucket chain comprising buckets of 4·5 cubic metres capacity. The spreader boom is 91·2m long and can discharge up to a height of 34m. The total weight of 3000 tons is supported on 192 wheels (128 under the spreader, 64 under the loader). Installed capacity is 6700kW.

The examples which have been mentioned are, of course, in no way exhaustive, but have been adduced to give an idea of the very large sizes which opencast excavators have reached. Tables VIII, IX and X give technical details of the heavy

TABLE IX—*Recent Rotary Bucket Excavators in Rhenish Brown Coal Mines*

(Fried. Krupp Maschinen- und Stahlbau Rheinhausen)

| Model | SchRs $\frac{100}{0{\cdot}5}$.10 | SchRs $\frac{250}{0{\cdot}6}$.12 | SchRs $\frac{800}{1{\cdot}5}$.28.12 | SchRs $\frac{1350}{1{\cdot}5}$.28 | SchRs $\frac{1350}{2{\cdot}5}$.28 | SchRs $\frac{1500}{5}$.28 | SchRs $\frac{2000}{5}$.32 | SchRs $\frac{4000}{5}$.50 | SchRs $\frac{150}{7}$.12 |
|---|---|---|---|---|---|---|---|---|---|
| Commissioned | 1951 | 1955 | 1952 | 1953 | 1955 | 1957 | 1958 | 1956 | 1955 |
| Number Built | 3 | 5 | 1 | 2 | 1 | 2 | 3 | 1 | 1 |
| Bucket volume, litres | 100 | 250 | 800 | 1350 | 1350 | 1500 | 2000 | 4000 | 150 |
| Wheel diameter, metres | 3·5 | 5·0 | 8·2 | 10·0 | 11·5 | 11·0 | 11·5 | 18·0 | 5·5 |
| Wheel design: (*a*) with cells, (*b*) without cells | (*a*) | (*b*) | (*a*) | (*a*) | (*b*) | (*b*) | (*b*) | (*a*) | (*b*) |
| Output capacity, cubic metres per hour | 200 | 900 | 1630–1920 | 2260–2620 | 2080–2540 | 3240 | 6000 | 8500 | 700 |
| Maximum cutting height, metres | 10 | 12 | 28 | 28 | 28 | 28 | 32 | 50 | 12 |
| Maximum cutting depth, metres | 0·5 | 0·6 | 1·5 | 1·5 | 2·5 | 5 | 5 | 5 | 7 |
| Length of wheel boom, metres | 10·1 | 12·6 | 25·7 | 36·3 | 45 | 36 | 42 | 67 | 19·5 |
| Feed of boom, metres | — | — | 12 | — | — | — | — | — | — |
| Length of discharge boom, metres | 11·0 | 15 | 25 | — | — | — | — | — | 22 |
| Length of connecting bridge, metres | — | — | — | 15·5+23 | 59·5 | 60 | 60 | 96 | — |
| Possible movement of bridge, metres | — | — | — | 4 | 12 | 18·5 | 10 | 24 | — |
| Width of conveyor belts, metres | 0·8 | 1·1 | 1·8–1·6 | 1·8–1·6 | 1·8 | 2·0 | 2·4–2·0 | 2·6 | 1·2–1·0 |
| Number of caterpillar tracks of excavator | 2 | 2 | 6 | 6 | 6 | 6 | 12 | 12 | 2 |
| Number of caterpillar tracks of loader | — | — | — | 2 | 2 | 3 | 6 | 3 | — |
| Installed electric capacity, kilowatts | 90 | 210 | 1000 | 3100 | 3200 | 3700 | 7400 | 14,800 | 400 |
| Total weight, tonnes | 80 | 220 | 1500 | 1800 | 1850 | 2100 | 3200 | 6000 | 320 |

machines supplied by one firm (Fried. Krupp Maschinen- und Stahlbau Rheinhausen). The figures show the trend towards larger and larger unit sizes, towards the use of the rotary bucket excavator, and the increasing application of cell-less bucket wheels in place of those equipped with cells.

### Development of the Rotary Excavator Wheel

Since 1935, when rotary bucket excavators were first successfully introduced into opencast lignite mining in Germany, the size of such machines has increased from about 200 to 6000 tons, and their output capacities from 500 to over 10,000 cubic metres per hour. It is claimed that for the applications and soil conditions prevailing in the opencast brown coal mines the rotary excavator shows many advantages compared with its rivals, the dragline and the bucket chain excavator. Compared with the dragline, its output, and therefore its power demand, is continuous, and the absence of peak loads is stated to contribute to a long life (fifteen to eighteen years, against ten to twelve years for draglines). Power consumption per cubic metre of excavated soil averages 0·5kWh to 0·7kWh for draglines, while rotary excavators reach consumptions of 0·3kWh to 0·5kWh, the consumption of bucket chain machines being intermediate between the two.

As a figure of comparison of different designs of excavator, the quantity (machine weight) ÷ (maximum output capacity × maximum vertical range) has been suggested. For draglines, bucket excavators, and bucket chain excavators this figure ranges from about 21 to 28 (kg.h/m⁴), while the largest rotary bucket machines reach values of under 10 (kg.h/m⁴), as the following table shows, in which nineteen machines are compared :—

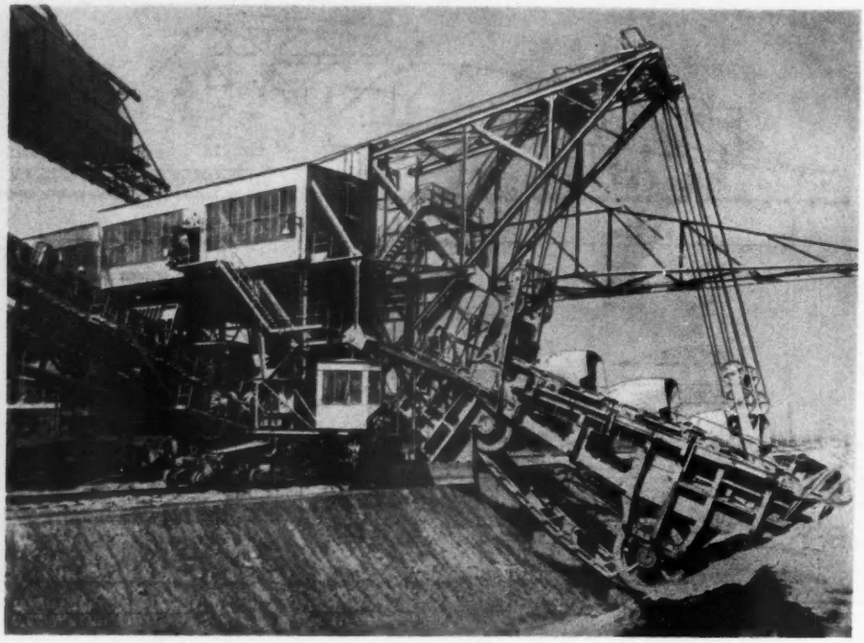
| Design | Bucket capacity, cubic metres | Output, cubic metres per hour | Maximum cutting height, metres | Total weight, tonnes | Kilogramme-hour, metres⁴ |
|---|---|---|---|---|---|
| Draglines (5) ... ... ... ... ... ... | 1·5–46 | 155–3300 | 10·1–27·5 | 42·6–2050 | 27·2–22·4 |
| Bucket excavators (3) ... ... ... ... | 7·6–23 | 298–840 | 58 | 460–1120 | 26·6–23 |
| Bucket chain excavators (4) ... ... | 0·4–1·4 | 575–1720 | 32·5–40 | 460–1430 | 28·3–20·9 |
| Rotary bucket excavators (7) ... ... | 0·1–4·0 | 330–8500 | 10·5–55 | 683–4530 | 19·4–9·7 |

As compared with the last-mentioned kind of plant, maintenance is easier and less costly in the case of rotary bucket machines on account of the smaller number of buckets and other parts subject to wear. Another important factor is the ease with which the rotary excavator can be applied to work uneven seams.

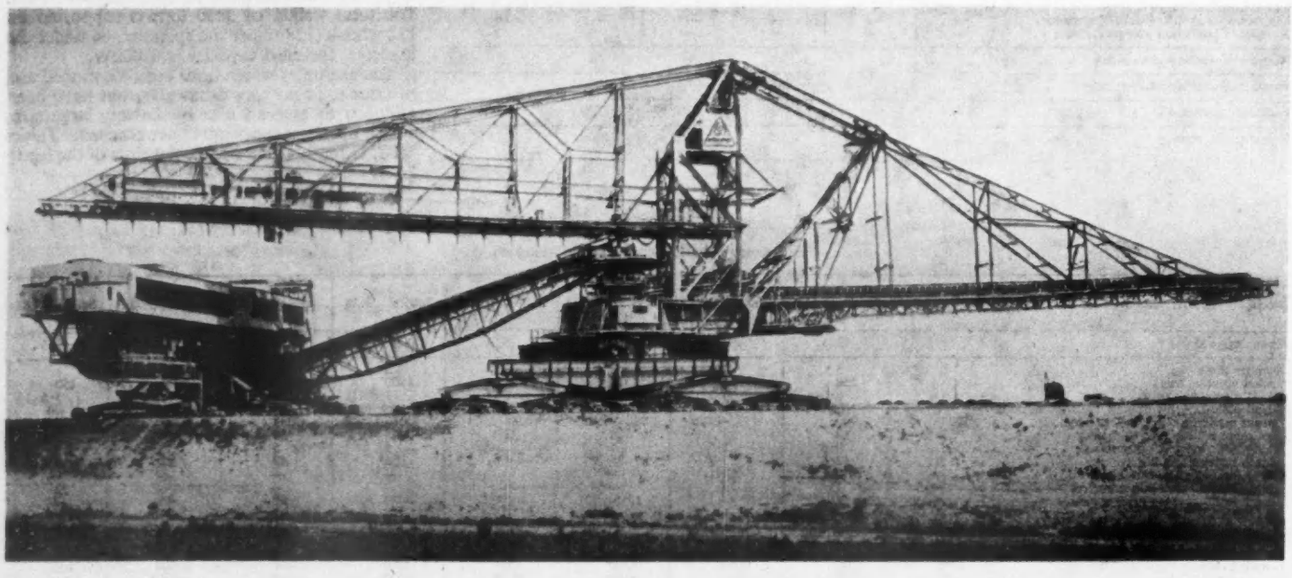
Bucket wheels are equipped with six to twelve buckets. Normally, these begin to cut near the bottom position and cease cutting at a certain distance above the centre line. As the bucket is raised higher still, the material falls out through the open bottom and is guided out of the wheel on to a conveyor. This guiding is done in the older design of wheel, by radial compartments or cells which are open on the side towards the conveyor. More recently, the cell-less wheel was introduced, which dispenses with compartments, the material being extracted by a chute, rotary plate, roller grid, or similar device, and deposited on a belt conveyor as before. It is clear that there must be a maximum speed above which the bucket wheel cannot discharge on account of centrifugal force exceeding gravity. Even below this speed, however, discharge is limited in the case of cell wheels to a small arc near the top position. Elsewhere, it is impeded or stopped by friction on the cell walls leading to clogging. While this factor makes it necessary to run the cell-equipped wheel at 40 to 60 per cent of the theoretical maximum speed, the cell-less wheel can be run at speeds approaching the maximum, since there is no friction inside the wheel and discharge can take place over a much greater arc. As a result, the output from the cell-less wheel is nearly twice as great as from a cell wheel. In order to keep the wear of the bucket edges down to reasonable values, the linear bucket speeds should not much exceed 5m per second. Sizes of wheels vary from about 1·4m diameter for 50 cubic metres per hour to 18m for 8500 cubic metres per hour, requiring driving powers of 20 h.p. to 1500 h.p.

With the giant machines described above, cutting is carried out by slewing the boom on which the rotary wheel is mounted, while the excavator undercarriage remains at rest. After each such cut at constant height and over an arc of up to 90 deg. or more, the boom is adjusted in height to the next level and the machine moved on its undercarriage to a new position, so that the whole front is successively cut away at a slope of 36 deg., in a series of cuts each about two-thirds of the diameter of the bucket wheel.

(*To be continued*)



**Bucket chain loading unit of slewing spreader. Bucket capacity 4·5 cubic metres**



**Slewing spreader for high and deep dumping. Total length of conveyor 90m**

# Linden Steam Power Station

No. II—(Concluded from page 911, June 13)

BY OUR AMERICAN EDITOR

*The Linden steam power station of the Public Service Electric and Gas Company in New Jersey is one of the most interesting generating schemes to go into operation in the United States recently. The station has been built next to the Bayway refinery of the Esso Standard Oil Company to obtain a mutually advantageous combination of two industrial processes : the processing of crude oil to refined petroleum products and the conversion of refinery residuals to electric energy. The refinery can effectively use the low-level heat energy of the power station, and the power station can make good use of the residuals of the refining processes. The Linden generating station comprises two 225MW turbo-generators having respective throttle pressures of 2000 lb and 2350 lb per square inch gauge and respective superheat conditions of 1050 deg. and 1100 deg. Fah.*

## Steam Generating Equipment

THE three identical boilers of the first unit are of the Babcock and Wilcox radiant type, using small tubes, 2in and 2½in outside diameter, with radiant platen superheaters, and steam washers, as shown in Fig. 9. They are constructed for pressure firing without induced draught fans. In view of the necessity of maintaining the desired temperature of the process steam over a wide range of flow, these boilers are designed for full steam temperature at 65 per cent of full load, with spray attemperation to control temperature from that point to full load. This characteristic is not difficult to obtain in these boilers because the amount of heat absorbed in the superheater is relatively small compared to total heat absorption. Radiant platen superheaters were selected because they help to maintain a relatively constant steam temperature over a wide range, and because they reduce the gas temperature entering the convection surfaces and thus minimise slagging. The steam generated in the boilers is washed with the pure feed-water in a two-stage washer.

In view of the possibility of burning pulverised fuel at some future time, these boilers are designed to facilitate a change-over to slag-tap furnaces. There is less heat absorbed in the furnace when solid fuel is fired instead of oil and, in addition, the furnace heat absorption is further reduced when the lower surfaces are covered to facilitate slag tapping. When and if the change-over occurs, the radiant platen superheater surface will be converted to platen boiler surface, and gas recirculation will then be used to lower the furnace exit gas temperature to acceptable levels by tempering. These changes are not expected to affect the steam temperature.

The boiler for the second unit is of the Babcock and Wilcox radiant type, using small tubes, 2in and 2½in outside diameter, with both the superheater and reheater of the radiant platen type, two furnaces, gas recirculation and steam washers, as shown in Fig. 11. It is constructed for pressure firing without induced draught fans. In this boiler a relatively high proportion of the total heat generated is absorbed in the superheater and reheater. To facilitate the heat transfer, three distinctive design methods are employed : (*a*) radiant platens ; (*b*) two furnaces with differential, or bias, firing, and (*c*) gas recirculation, not only at the control load, but also at full load. The high-temperature section of the superheater is in one half of the boiler and the entire reheater is in the other half. The low-temperature sections of the superheater are distributed in both halves. This boiler was constructed with several design features which permit possible future change-over from oil to pulverised fuel firing with a minimum outage. These features include a division wall in each furnace, a Bailey block floor, space for gas tempering ports, gas tempering ductwork, and space for slag taps and tanks at the bottom of the furnaces. When and if these changes are made, it is the plan : (1) to alter the original pattern of the gas recirculation ; (2) to apply full studding to the furnace and division wall tubes in the slag zone ; (3) to install pulverising and firing equipment for solid fuel, and (4) to install slag and dust removal equipment.

The temperature of the high-pressure steam is controlled by gas recirculation, while differential firing controls the reheated steam temperature. Attemperation is used to trim the high-pressure steam temperature. When oil is being fired, the recirculated gas is mixed with the combustion air and it enters the furnace through the burners, which are suitable to burn pulverised fuel and gas as well as oil. The three horizontal-shaft Ljungstrom air heaters are designed so that all of the heating surface may be removed radially by hoisting from the top. Extraction steam is used to heat the entering air. Dampers are provided to permit washing the air heaters at reduced load on the unit.

## Turbo-Generators

The turbine of the first unit is said to be a record-breaking machine in at least two respects. The throttle steam flow of 2,800,000 lb per hour, which corresponds to a rating of 425MW in a straight condensing, conventional reheat machine, is claimed to be the largest in the world. The rating of 225MW makes it the largest automatic double-extraction turbine ever built in the United States. The throttle steam conditions for the first turbo-generator are 2000 lb per square inch gauge and 1050 deg. Fah. The maximum total extraction steam flows are 600,000 lb per hour at 750 lb per square inch gauge and 1,000,000 lb per hour at 150 lb per square inch gauge, although the sum of the two is limited to 1,150,000 lb per hour at any one time. The General Electric unit is designed to produce 225MW output over the entire range from maximum to zero extraction. Under the latter condition, which is abnormal, steam is by-passed externally from the 150 lb per square inch gauge extraction point (the exhaust of the low-pressure extraction element) to the cross-over entering the triple-flow low-pressure element.

A cross section of the entire turbine is shown in Fig. 10. Because of the unusually large throttle flow, the high-pressure element has a double-flow arrangement in which the extraction steam for process flows toward the generator,

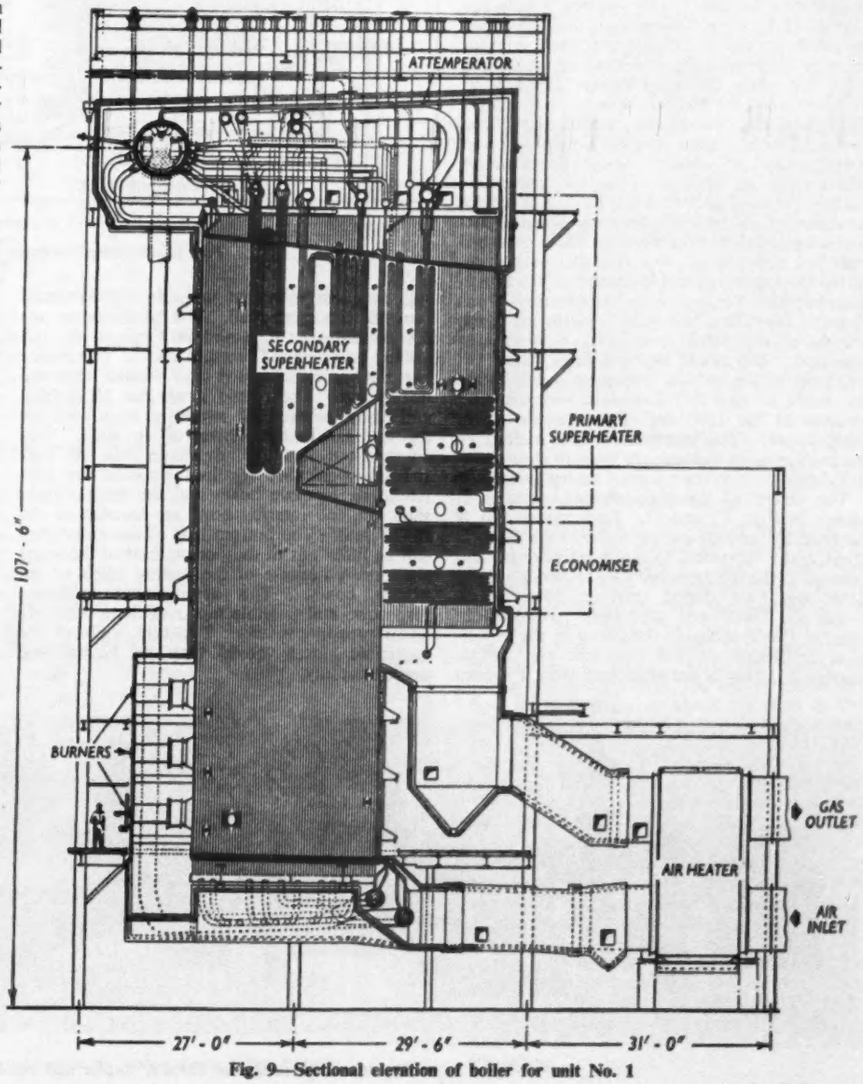



Fig. 9—Sectional elevation of boiler for unit No. 1

and the steam destined for the condenser flows toward the front standard. The steam expansion from the 750 lb per square inch gauge extraction point to the 150 lb per square inch gauge extraction point takes place in a separate casing at the front standard end of the unit. The double-flow arrangement of the high-pressure element has three important advantages. In the first instance, splitting the high-pressure steam path into two streams brings the steam flow per wheel within the range of current experience. Secondly, it avoids the necessity of designing control valves for flows of very large volume at the two extraction steam pressures ; the control valves on the upper and lower halves of the low-pressure extraction element have to pass a total flow of only 1,000,000 lb per hour of the 150 lb per square inch gauge extraction steam at a pressure of 750 lb per square inch gauge. Thirdly, the opposing flows of steam minimise the changes in total turbine thrust due to variations in either electrical load or process steam extraction.

The second generator is driven by a 225MW, 3600 r.p.m., tandem-compound, triple-exhaust flow, automatic single-extraction General Electric turbine. It has a maximum throttle flow of 1,820,000 lb per hour and operates with manually controlled extraction of 400,000 lb per hour at 150 lb per square inch gauge. The maximum throttle flow of this machine is equivalent to 275MW capacity for a straight condensing reheat unit. The throttle steam conditions are 2350 lb per square inch gauge and 1100 deg. Fah. with reheating to 1050 deg. Fah. The unit has four separate shaft spans. The expansion of the steam from 2350 lb per square inch gauge to the 450 lb per square inch gauge reheat pressure performs work in the nine-stage, single-flow, high-pressure element which comprises the first span between No. 1 and No. 2 bearings. The second span between No. 3 and No. 4 bearings consists of the extraction element, through which the 150 lb per square inch gauge extraction steam expands, and the reheat turbine in which the 1050 deg. Fah. reheated steam expands to approximately 200 lb per square inch gauge. These two elements of the turbine have been combined in this span in such a manner as to bring stages of nearly equal temperatures adjacent to one another. The six-stage intermediate-pressure turbine and the six-stage single-flow portion of the triple-flow low-pressure turbine are combined in the third span between No. 5 and No. 6 bearings. The double-flow portion of the low-pressure turbine comprises the fourth span between No. 7 and No. 8 bearings. Three rows of 26in long last stage buckets are used, and the exhaust hood has two side-outlet exhaust openings. The single external valve chest, the two stop valves and the first stage nozzle boxes are made of type 347 austenitic stainless steel because of the 1100 deg. Fah. throttle steam temperature. The inner and outer casings of the high-pressure element are made of chromium-molybdenum-vanadium ferritic casing material.

The design of the high-pressure element is shown in Figs. 12 and 15. Each nozzle box is fed from its separate control valve in the external chest, and is supported so that it is free to expand relative to the ferritic inner shell in coming up to 1100 deg. Fah. during start-up. The nozzle boxes are firmly and accurately positioned in spite of the appreciable difference in the expansion coefficients of the austenitic and ferritic materials. This is accomplished with a special split ring and yoke that supports the individual boxes in the inner shell. The nozzle boxes are fabricated from two closed-die forgings, and are welded into a closed pressure vessel. The nozzle partitions are fabricated and welded into the nozzle box. The nozzle boxes can be quickly and easily removed for inspection from both the top and the bottom halves of the shell. This construction has the advantage that no high strength welds are required between the austenitic steel nozzle boxes and the ferritic inner shell, and no internal bolts are situated in the steam path. The bottom half of the inner shell can be lifted out of the bottom half of the outer shell easily because of the vertical inlets of the nozzle boxes. This arrangement facilitates inspection and possible repair of these relatively small pressure vessels. The thin walls of the austenitic nozzle boxes may be heated and cooled rapidly.

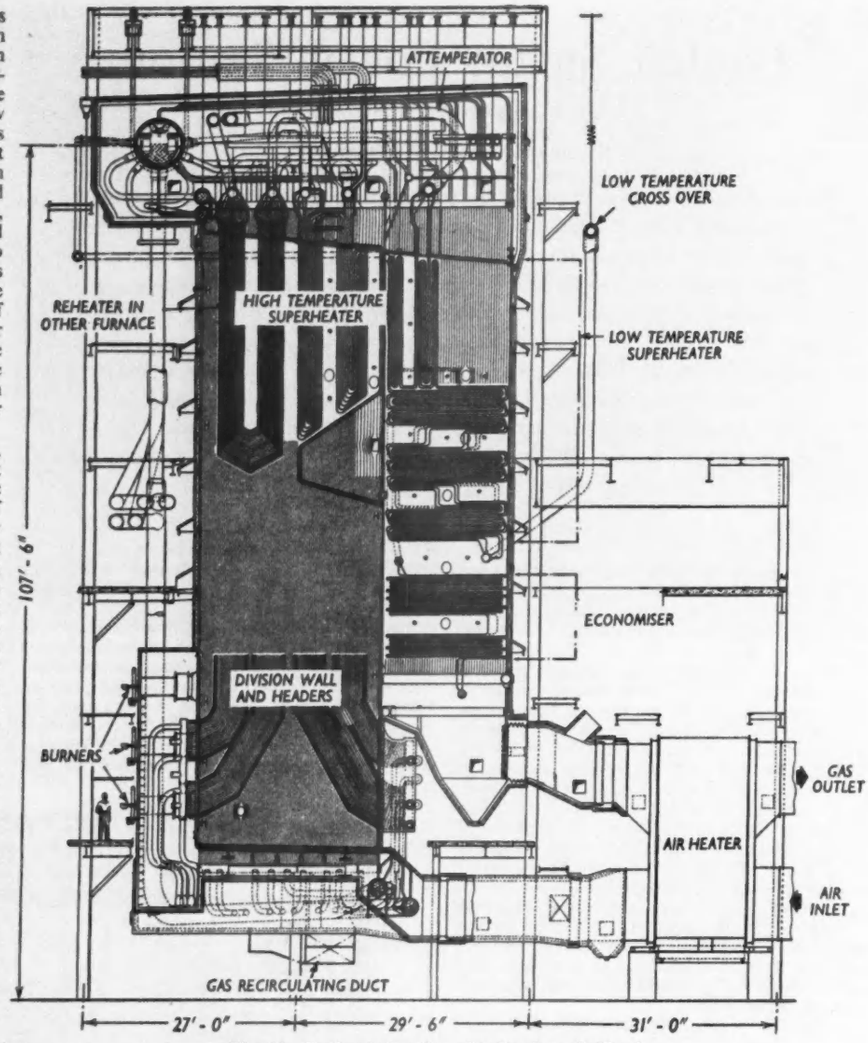



Fig. 11—Sectional elevation of boiler for unit No. 2

### Water Treatment

The water treatment plant is divided into two stages of processing : the primary treatment and the demineralising process. The primary treatment equipment is shown diagrammatically in Fig. 13 and is designed to operate unattended, by remote manual or automatic control. It receives raw water (which is fresh water drawn from nearby creeks) from the Esso reservoirs, chlorinates it to the break-point, chemically treats it for coagulation of impurities, allows it to settle, filters it, and then delivers it to the demineralisers. It is capable of producing 3750 gallons per minute of effluent essentially free of turbidity, colour, oil and organic matter. The principal items of the primary water treatment plant are the chlorination equipment, the two vertical, up-flow coagulating and clarifying units, the four gravity filter units, which are constructed as integral parts of the coagulating and clarifying

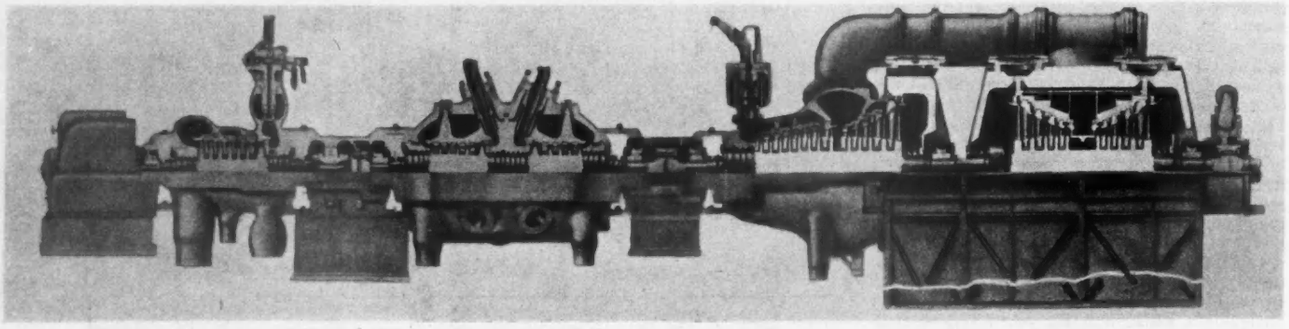


Fig. 10—Cross section of 225MW turbine unit No. 1

units, and the necessary auxiliary equipment consisting of pumps, chemical storage, feeding and mixing equipment. Automatic sludge removal is provided in the settling chambers. Each filter has automatic control to remove it from service, backwash it and return it to service. The filter-bed material is anthracite.

The process diagram of the demineralisation system is shown in Fig. 15. The water from the primary treatment system flows through cation units for removal of calcium, magnesium and sodium ions ; through a vacuum degassing unit for the removal of oxygen and carbon dioxide ; through combination weak-base anion/strong-base anion units for the removal of sulphate, chloride and nitrate ions and silica ; and finally through mixed bed units containing cation and strong-base anion resin for the removal of trace impurities and then into storage. There are seven cation units, one vacuum degassing unit, six combination anion units, five mixed bed units, and two 500,000 gallon demineralised water storage tanks. All of the ion exchange units, which are among the largest ever built, are 12ft in diameter. The quality of the effluent is specified not to exceed :

| | |
|---|---|
| Total dissolved solids ... ... ... | 0·2 p.p.m. |
| Dissolved silica ... ... ... ... | 0·01 p.p.m. |
| Total silica ... ... ... ... | 0·02 p.p.m. |
| Conductivity ... ... ... ... ... | 0·5 micromhos |

The demineralising plant is designed to produce continuously 3200 gallons per minute of water of guaranteed quality with an influent having a total dissolved solids content of approximately 300 p.p.m. Provisions have been made for a future expansion of the plant to 4800 gallons per minute capacity. The regeneration and control of the demineralising equipment also is completely automatic and the entire water treatment plant is designed to be run by two operators per shift.

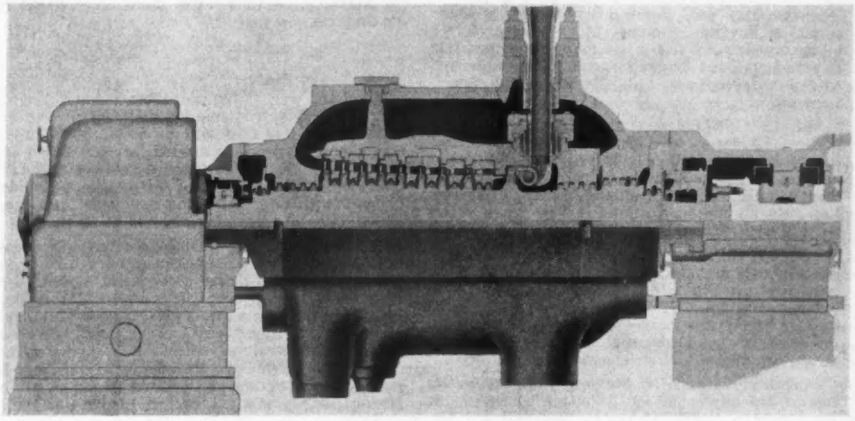


Fig. 12—Cross section of high-pressure element of turbine No. 2

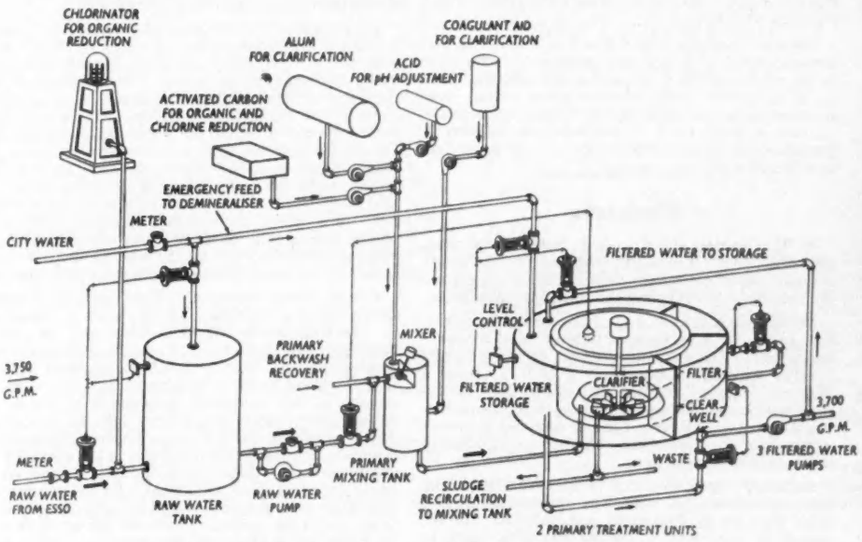



Fig. 13—Diagram of primary feed water treatment at Linden

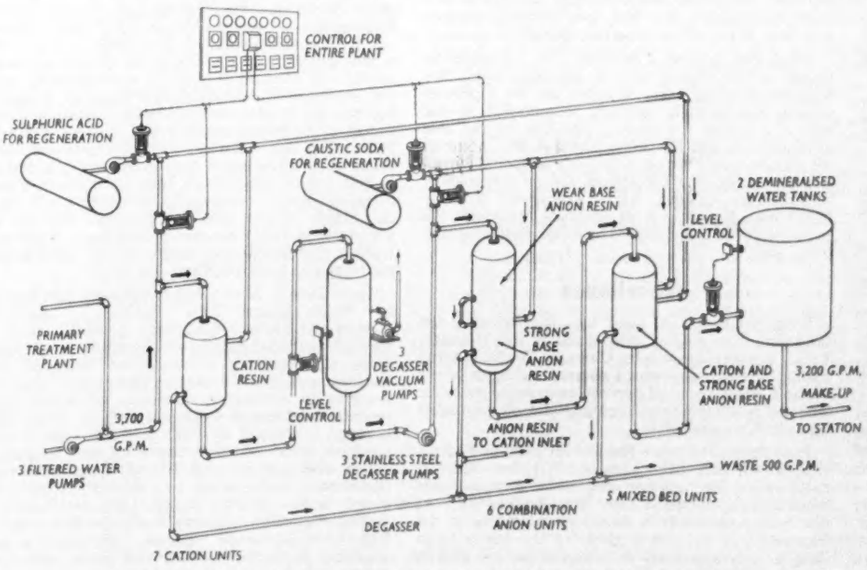



Fig. 14—Diagram of feed water demineralisation at Linden steam power station

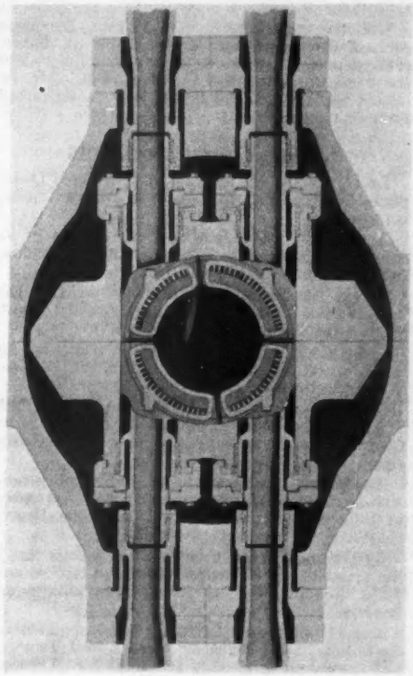


Fig. 15—Cross section of inlet nozzle boxes on turbine No. 2

### Fuel Systems

Two complete fuel oil systems have been provided ; one to burn the high viscosity fuel, and one to burn "Bunker C" fuel. Each boiler furnace has three horizontal rows of four burners. The systems are arranged so that the operator can fire either fuel in any row of burners. The high viscosity fuel is supplied to the burners at about 1000 lb per square inch gauge and 450 deg. Fah. At this temperature its flow characteristics are about the same as those of "Bunker C" fuel. The system is designed on the assumption that the fuel will solidify at 275 deg. Fah. Steam tracing heats the entire length of the large lines as far as the boiler stop valve. From that point to the burners, electric resistance heating of the pipes themselves is used. Mechanical seals, supplied from a separate seal oil system, are used on all rotating equipment of the high viscosity fuel system because of the amount of sediment involved. The sealing oil is "Bunker C" at 200 deg. Fah., filtered to a cleanliness that allows passage through a 40 micron sieve. The flow of the high viscosity fuel is measured by gauging in the tanks. There are two 20,000 barrel metering tanks, with a 1600 barrel transfer tank to allow for a period of zero flow in both large tanks while the gauges are taken.

# Personal and Business

## Appointments

MR. PETER H. JACKSON has been appointed home sales manager of the Lancashire Dynamo Group.

MR. S. A. GREGORY, M.I.Chem.E., has been appointed technical manager, dryer division, of Birlec, Ltd.

MR. ROBERT SPEIRS, M.I.E.E., has joined the Electric Construction Company, Ltd., Wolverhampton.

THE TRIANGLE VALVE COMPANY, Ltd., has appointed Mr. S. Kendall to the post of advertising and publicity manager.

MR. J. L. R. WILKINSON has been appointed technical sales representative for the north-western area of British Central Electrical Company, Ltd.

TILTMAN LANGLEY, Ltd., announces that Mr. J. C. Stevenson, F.R.Ae.S., has been appointed chief technician, and Mr. E. F. Maillard, metallurgist.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, Ltd., has announced that Sir Alexander Sim is to be appointed chairman upon the retirement of Sir John Dalton.

THE BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION has announced that Dr. W. A. Baker, research manager, is leaving at the end of July to join the Northern Aluminium Company, Ltd. Mr. A. Cibula and Mr. R. Eborall have been appointed research superintendents.

## Business Announcements

DICTAPHONE COMPANY, Ltd., has registered Dictaphone European Exports, Ltd., as an overseas trading company.

ARMCO, Ltd., announces that the address of its head office is now 76, Grosvenor Street, London, W.1 (telephone, Hyde Park 9711).

BRITISH INSULATED CALLENDER'S CABLES, Ltd., has opened a new Dundee sales branch office at 2, South Ward Road, Dundee (telephone, 5926/7).

CHARLES COLSTON, Ltd., announces that it has set up an export department at 3, Mill Street, London, W.1, under the management of Mr. Ernest Gray.

SHORT BROTHERS AND HARLAND, Ltd., Belfast, states that it has acquired the British Straddle Carrier Company, Ltd., with all manufacturing and marketing rights.

THE BRITISH INDUSTRIAL MEASURING AND CONTROL APPARATUS MANUFACTURERS' ASSOCIATION has moved to 9, Argyll Street, London, W.1 (telephone, Regent 0568).

SHEEPBRIDGE ALLOY CASTINGS, Ltd., states that it has appointed E. H. Bennet and Son, 124, Seymour Place, London, W.1, as its southern area representative.

JAMES HODGKINSON (SALFORD), Ltd., has purchased the ordinary share capital of J. and J. Neil (Temple), Ltd., combustion engineers, Temple Park Iron Works, Glasgow, W.3.

UNITED DOMINIONS TRUST, Ltd., announces that as from Monday, June 16, its St. Albans office will operate from 29, London Road, St. Albans (telephone, St. Albans 55412/3).

THE BRITISH ASSOCIATION OF MACHINE TOOL MERCHANTS is to move to Effingham House, Arundel Street, Strand, London, W.C.2 (telephone, Temple Bar 6101/4), on June 24.

BRUCE PEEBLES AND CO., Ltd., East Pilton, Edinburgh, 5, states that its works will be closed during the Edinburgh trades holiday, from Friday evening, July 4, until Monday morning, July 21.

THE CANDY FILTER COMPANY, Ltd., announces that its chemical pump division has been formed into a separate company under the name Metering Pumps, Ltd., 21, The Mall, Ealing, London, W.5.

ROTO-FINISH, Ltd., Mark Road, Hemel Hempstead, Herts, states that it has acquired from Jacquet-Hispano Suiza, S.A., the controlling interest in Modern Electrolytic Patents and Processes, Ltd.

POWELL DUFFRYN CARBON PRODUCTS, Ltd., Springfield Road, Hayes, Middlesex, states that its works will be closed from 5 p.m., Friday, July 25, until 8 a.m., Tuesday, August 12, for the annual holiday.

HONEYWELL-BROWN, Ltd., has changed its name to Honeywell Controls, Ltd., and all head office departments and the London branch office have been moved to Ruislip Road East, Greenford, Middlesex (telephone, Waxlow 2333).

THE HOTPOINT ELECTRIC APPLIANCE COMPANY, Ltd., has announced the retirement of Mr. H. O. Buckingham, sales director, after forty-six years' service in the A.E.I. Group of Companies, twenty-six of which have been with Hotpoint.

AEROPREEN PRODUCTS, Ltd., has acquired an additional factory at Lindsay Avenue, High Wycombe, Bucks (telephone, High Wycombe 1242), which will in future house the main manufacturing, laboratory, development and office facilities of the company.

SPECIALLOID, Ltd., has acquired the major share capital of Powder Couplings, Ltd. As from July 1 all communications relating to the manufacture, sale or servicing of powder couplings, should be addressed to Powder Couplings, Ltd., 20, Black Bull Street, Leeds, 10.

MR. C. G. HARRISON, general manager of the Malayan Railway Administration, has announced that he is leaving Malaya on leave prior to retirement and proceeding to Australia to take up an appointment with the Commonwealth Engineering Company, Ltd. His address in Australia is New South Wales Bank, Queens Street, Brisbane.

THE ENGLISH ELECTRIC COMPANY, Ltd., states that its Birmingham branch has been moved from 75, New Street, to Pitmaston, Moseley, Birmingham, 13 (telephone South 4021/5). The domestic appliance sales section is also located in the new premises, but the appliance service depot remains at 175, Tennant Street, Birmingham, 15 (telephone, Midland 2803).

FOLLSAIN WYCLIFFE FOUNDRIES, Ltd., announces that it has appointed the following agents :—for the Union of South Africa, H. Incledon and Co. (South Africa), Ltd., P.O. Box 3620, Johannesburg ; for Northern Rhodesia (except Livingstone), J. L. Curtis, Ltd., P.O. Box 140, N'dola ; for Southern Rhodesia and Livingstone, Mine-Elect (Pvt.), Ltd., P.O. Box 316, Bulawayo.

LONDON TRANSPORT states that it is considering the application of electronic data processing techniques to the administrative work of the organisation. Mr. C. J. Cornwall, staff administration officer, has assumed responsibility for the electronic data processing unit, and Mr. G. O. Gallop has been transferred from the establishment office to the unit and promoted to principal executive assistant.

## Contracts

W. H. DORMAN AND CO., Ltd., Stafford, has been awarded a contract to supply twenty-eight " L " four-cylinder diesel engines to drive stand-by generators required for a NATO pipeline installation in Belgium.

WESTLAND AIRCRAFT, Ltd., has received a production order for a substantial number of " Wessex " helicopters. The aircraft, a variant of the Sikorsky " S.58 " (United States Navy " HSS "), using a Napier " Gazelle " free turbine, will have automatic stabilisation and piloting facilities to allow all-weather operation, and will have homing weapons to attack submarines after detection. Delivery is expected to commence early next year.

RICHARD SUTCLIFFE, Ltd., Horbury, Wakefield, has received an order valued at more than £250,000 from Sir Lindsay Parkinson and Co., Ltd., for the supply of equipment to handle 800 cubic yards of overburden per hour at a new opencast coal site, Dunraven Deep, in South Wales. The equipment includes twelve 48in wide, 80 h.p. conveyors, two multi-plate feeders, four 60in wide mobile conveyors and three throw-off carriages and spreader conveyors.

YORKSHIRE ENGINE COMPANY, Ltd., Sheffield (a branch of the United Steel Companies, Ltd.), has received an order worth £350,000 for the supply of sixteen diesel-electric shunting locomotives to the Port of London Authority. The first of the new locomotives is due for delivery next April. Some of the locomotives now on order will be twin-engined, 400 h.p. units, and the others will be powered by single 300 h.p. engines. All the engines are of Rolls-Royce manufacture and the electrical equipment will be supplied by the British Thomson-Houston Company, Ltd.

## Miscellanea

WIRE STRIPPER.—A hand tool for stripping the insulation from electric cable made by Elliott-Lucas, Ltd., Churchbridge Works, Cannock, Staffs, is fitted with a knurled screw which governs the depth of cut of the V-notch jaws and prevents severing of the wire. The tool is suitable for stripping insulation from cable up to 0·029in diameter.

POLYTHENE TUBING.—The British Plastics Federation, 47/48, Piccadilly, London, W.1, has issued a specification for tube for cold water services made from high density polythene. Specification B.P.F.42 has been prepared by a technical committee of the Federation to provide a guide to the use of high density polythene and is intended as an interim measure until a British Standard is prepared.

LARGE PNEUMATIC WINCH.—A pneumatic winch now being made by Globe Pneumatic Engineering Company, Ltd., Romford, Essex, is powered by a 10 h.p. radial air motor. This winch has a safe lifting capacity of 3 tons and its average rate of lift is 50ft per minute. The drum takes 1000ft of ¾in diameter wire rope.

BUILDING AND CIVIL ENGINEERING AS A CAREER.—A new film, entitled " A World to Build," has been produced by Richard Costain, Ltd., and was shown in London last week. The film illustrates the training offered to young men entering the industry, and the opportunities that exist with the company. Much of the company's work is abroad, in Africa and the Middle East, and other under-developed countries, and the film shows many of the projects at present under construction and some that have been completed. The film is available on loan in 16mm size.

PRECISION BELLOWS.—A range of precision seamless bellows and bellows assemblies introduced by Avica Equipment, Ltd., Hemel Hempstead, covers sizes from 3·8in to 12in bore. It is stated that in these bellows a tolerance in spring rate as low as plus/minus 10 per cent can be provided for on a production basis, while the dimensional tolerances are appreciably tighter than previously. Plus/minus 0·005in may be held for the external and internal diameters of the corrugations if required, and as low as plus/minus 0·005in on the diameter of the end terminations if other than flush. The bellows are available in any of the conventional materials, and although normally supplied in the cold-worked condition, heat treatment can be carried out if specified.

SHIPBUILDING CENTENARY.—This year the shipbuilding and engineering firm of Philip and Son, Ltd. celebrates the centenary of its founding by George Philip at Dartmouth in Devon. This achievement of 100 years of shipbuilding is recorded in a volume, entitled " A Century of Progress," which includes some historical notes on the shipbuilding industry in Dartmouth and then goes on to outline the development of the company which now has the fourth generation of the Philip family as managing director. The book includes particulars of the Sandquay and Noss yards and also an interesting chapter on Dartmouth and its early days, while the remainder of the volume illustrates some of the wide variety of craft which the company has built during the past century.

LARGE DRONE AIRCRAFT.—The Canberra U Mark 10 aircraft is a conversion of the standard Canberra B. Mark 2, which has been developed by Short Brothers and Harland, Ltd., in conjunction with English Electric for unmanned operation in guided weapon firing trials. The Canberra U Mark 10 is capable of fully automatic operation in all phases of flight. Many operations in the U.K. have already been carried out with the aircraft under remote radio control : a pilot always has flown in the aircraft but during many of these flights he has not touched a control from take off to landing. Its advantages for the target role include its high altitude capabilities ; large reflecting surface, which will permit a missile to home on a target of representative size ; and endurance at height.

LIGHTWEIGHT STRUCTURE FOR TROPICAL BUILDINGS.—Sherbourne Engineering, Ltd., Acocks Green, Birmingham, is now marketing a lightweight structure for use in the tropics. The design was evolved to provide an economical frame, for low cost housing, capable of carrying corrugated roof cladding, and with the walls constructed of local materials, in panels between the tubular steel supporting columns. Two widths of buildings are provided, namely 15ft and 21ft each of which can have a 7ft 6in wide cantilever verandah, and the length can be any multiple of 12ft or 10ft or a combination of both. The whole of this range of sizes is constructed from seven small interchangeable tubular steel components, any one of which can be easily handled by one man. Joints are bolted; cold-rolled steel rafters can be bolted below the trusses to carry a ceiling.

TOOL STEEL.—A new high-speed tool steel known as " Mushet Special ' V.G.' " has been introduced by Samuel Osborn and Co., Ltd., Sheffield. It is a specially-balanced tungsten-molybdenum super high-speed steel, containing cobalt for enhanced red-hardness with greatly increased carbon and vanadium contents to employ to maximum effect the great intrinsic hardness of vanadium carbide. This combination is claimed to result in a tool steel of high hardness, good abrasion resistance and toughness, which makes it suitable for all types of cutting operation. Tools made of the new material are stated to have a good performance, particularly in cutting the more abrasive materials and those of high work hardening capacity. The steel is now available in the form of lathe and planer tools, toolholder bits, &c., as well as in bars and blanks.

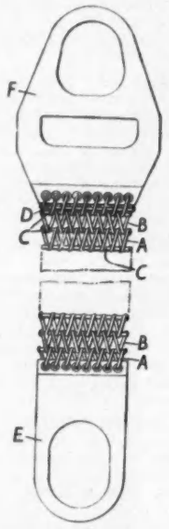
# British Patent Specifications

*When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.*

## LIFTING APPLIANCES

**795,489.** April 3, 1956.—WOVEN WIRE SLINGS, The British Wedge Wire Company, Ltd., Academy Street, Warrington. (*Inventor: Ernest Harold Kennett Jeffrey.*)

The invention relates to woven wire slings for use in the mechanical handling of loads by cranes, hoists or the like. In the particular form of construction illustrated in the drawing, the belt includes a number of laterally extending and oppositely coiled wires *A* and *B*, each lateral coil of the belt being welded at its opposite ends to a transverse rod *C* in such manner that each coil *A* and *B* embraces a pair of rods *C* and each rod has wound around it a pair of adjacent and oppositely directed coils. At one end of the belt the end coil *A* embraces a transverse rod and is welded to an additional cross rod *D*. The handles of the sling are shown at *E* and *F* and are preferably of boiler plate. The male handle *E* is smaller than the female handle *F* and has a substantially elliptical hole or slot adjacent its rounded end. The female handle *F* has a hole and a transverse slot, the former being for engagement by a hook of a crane such as for example when a basket hitch or a straight pull is desired. The transverse slot is of sufficient width to enable the end *E* of the sling to be passed through it for engagement with a crane hook when it is desired to lift a load by the sling wrapped around the load in the manner of a choke hitch.—*May* 21, 1958.

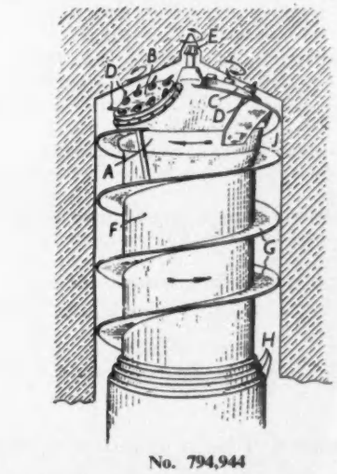


No. 795,489

## MINING ENGINEERING

**794,944.** June 25, 1956.—DRILLING HEAD FOR THE SINKING OF SHAFTS AND GALLERIES, Georges Allimann, 17 Rue de Champagne, Mulhouse, Haut-Rhin, France.

The invention has for its object a drilling head for the boring of levels, galleries, shafts, &c., in mines, quarries or works sites. The drilling head is rotatable and carries at least one rotating plate provided with picks, the rotational axis of the plate being inclined in such a manner that the picks strike one after the other into the material to be drilled and are then immediately withdrawn. The products broken off are continuously removed by the evacuation device. In the drawing, the drilling head *A* has two circular plates *B* and *C*. These plates rotate about their own axes and each carry at their periphery a series of picks *D*. The axes of rotation of the plates are inclined and located in a plane different from that in which the longitudinal axis of the head lies. The drilling head has a central pilot drill *E* which precedes a skirt or casing *F*, around which is fixed an Archimedian screw *G*. This skirt and screw in their turn precede a number of telescopic tubes *H*. A tipper or shovel *J* is formed on the head to bring the drilling products on to the evacuation screw *G*. In operation of this drilling head, the pilot drill *E* first of all attacks the rock which is to be drilled. This drill rotates in the opposite direction to the head *A* in order to compensate its reaction. By the rotation of the head on its own axis, and the rotation of the plates *B* and *C* and their positions, each of the picks *D* can strike the wall of the rock in its turn, after which it is immediately withdrawn in the same way as with the blow of a pick. The direction of rotation of the plates is not important. As the drilling head advances into the wall of rock, the telescopic tubes extend and push it outwards and the products collected by the screw can then be discharged by using the extended series of tubes.—*May* 14, 1958.

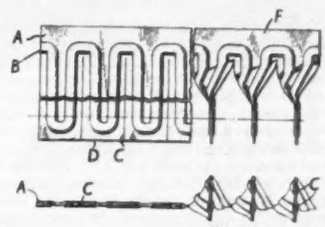


No. 794,944

## HEAT EXCHANGERS

**794,888.** June 27, 1956.—AN IMPROVED HEAT EXCHANGER, General Motors Corporation, Grand Boulevard in the City of Detroit, State of Michigan, U.S.A. (Assignees of Clifford Henry Wurtz).

The invention relates particularly to evaporators for refrigerators. The heat exchanger *A* shown in the drawings is an evaporator for a refrigerator and has a sinuous passage *B* in it. It is made by a roll-welding process; that is to say by welding two or more plates together by pressure between rolls with the application of heat if necessary. Prior to rolling, certain areas of the plates are covered with stop-weld material to the desired pattern of passages, and after welding, fluid under pressure is applied between the plates to dilate them in those areas, the plates preferably being held between a pair of flat dies. Aluminium is the most suitable material for carrying out this method. The passage *B* comprises a number of parallel U-shaped loops between which are cut slits *C* to form a number of fingers *D*, each having one U passage, which are twisted into a plane at right angles to that of the flat portion of the plate. When all the fingers are so twisted, the result is a roll-welded evaporator which is the equivalent of a fin-and-tube type, the fingers constituting a series of parallel cantilever fins with refrigerant passages within the fins. Modified designs are also shown in the specification.—*May* 14, 1958.

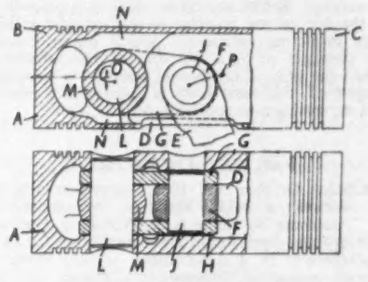


No. 794,888

## INTERNAL COMBUSTION ENGINES

**794,879.** September 17, 1956.—ENGINE DRIVING GEAR, Adolf Roth, 58, Kaupenstrasse, Essen, Germany.

The invention relates to driving gear in internal combustion engines, having two double-acting pistons and three combustion chambers per cylinder and having a crankshaft adjacent the cylinder. The object of the invention is to overcome difficulties and to decrease the side thrusts while, at the same time, increasing the strength of the piston. In the arrangement shown in the drawing, a piston *A* with two head portions *B* and *C* has in its cylindrical wall or skirt a slot *D* through which extends a rocking lever *E*, the upper end of which is equipped with a bearing *F*. The construction of the central and lower portions of the rocking lever may be conventional. The width of the slot *D* is slightly larger than the thickness of the lever. Links *G* and *H* of a two-part piston arm are disposed on opposite sides of the bearing *F* of the rocking lever. The links are pivoted at one of their ends to the rocking lever by a pivot pin *J*. The other ends of the two links *G* and *H* are pivoted to the piston by a pin *L* seated in end bearings provided in the piston skirt and in a central bearing *M*. This bearing, which is situated between the links and has the same width as the bearing *F*, is integral with ribs *N* forming part of the piston. As shown in the upper view, the axis of the aligned bearings is offset a distance *O* from the longitudinal axis of the piston. In the position of the rocking lever *E*, illustrated, the piston is close to the outer dead centre. In this position, which corresponds to maximum pressure in the corresponding combustion chamber, the longitudinal axis of the two-part piston arm *G* and *H* extends parallel to the longitudinal axis of the piston so that only a small side thrust is transmitted by the piston *A*. During the inward stroke of the piston the centre of the pin *J* moves along an arc indicated by the dotted line *P*, due to the displacement of the rocking lever *E*, with the result that the longitudinal axis of the arm *G* and *H* assumes different angular positions with respect to the longitudinal axis of the piston. The side thrusts occurring when each such different angular position is reached can be easily controlled, due to the reduced pressure in the combustion chamber prevailing during the inward stroke of the piston. At inner dead centre, i.e. when a high pressure prevails in the corresponding combustion chamber acting on the other head *C* of the piston *A*, the longitudinal axis of the piston arm *G* and *H* is again parallel to the longitudinal axis of the piston, so that, in this position of the piston the advantage of substantial elimination of side thrust is also obtained. A modified construction is also shown in the specification.—*May* 14, 1958.

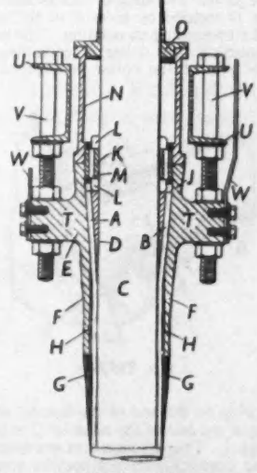


No. 794,879

## ELECTRICAL ENGINEERING

**795,400.** January 12, 1956.—ARMOURED CABLE JOINTS AND TERMINATIONS, British Insulated Callender's (Submarine Cables), Ltd., Norfolk House, Norfolk Street, London, W.C.2. (*Inventors: William Young Murray, Cyril Leyland Coy and William Starkey Wood.*)

The invention relates to joints and terminations for wire armoured electric cables and is particularly concerned with means for anchoring the ends of the armouring wires. Referring to the drawing, the ends of armouring wires *A* and *B* of a cable *C* are clamped between an inner member *D* and the inner conical surface of an outer member *E*. The outer member *E* is formed with an extension *F* which tapers towards a relatively thin-walled part which is sealed to the armoured cable by oil-resistant tape *G*. A thin brass sleeve *H* is arranged between the extension *F* and the cable armouring. The member *E* is also formed with a relatively short extension *J* which projects upwards beyond the larger end of the inner member *D*. This projection is internally threaded and receives a compression nut *K*. The nut has cylindrical end portions *L* of reduced diameter divided into segments by radially extending slots which register with a number of passages *M* through the central part of the nut. A part of the nut projecting beyond the upper end of the outer member *E* carries an internally screw-threaded cylin-



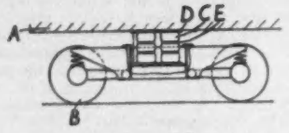
No. 795,400

der *N*, the lower end face of which makes joint with the upper end face of the member. A cover plate *O* which screws on to the top end of the cylinder *N* has a central aperture through which the cable core passes and a tapering wall surrounds this aperture. The upper end of this wall is sealed to the cable core by oil-resistant tape. The whole assembly is supported by two lugs *T* formed integrally with the outer clamping member *E*, the lugs being suspended from horizontal channel girders *U* by bolts *V*. Bonding strips *W* are anchored to the lugs *T* by set screws. Before the cover plate *O* is screwed on to the top of the cylinder *N* this cylinder is filled with insulating compound which passes through the passages *M* into the end of the armouring. When the flow of compound ceases, the cylinder is topped up, the cover plate is screwed into position and the sealing tape applied.—*May* 21, 1958.

### RAILWAY ENGINEERING

**796,182.** October 17, 1955.—SUPPORTS FOR THE BODIES OF RAIL VEHICLES, Maschinenfabrik Augsburg-Nürnberg A.G., Nürnberg, Germany.

It has now been found that air cushions for elastic displacement in a substantially vertical plane can absorb horizontal displacements without any considerable adverse effects on their elastic properties in vertical planes in contradistinction with helical springs. In view of this, it is proposed for rail vehicles having bodies supported on bogies through air cushions to absorb horizontal motions only by deformations of



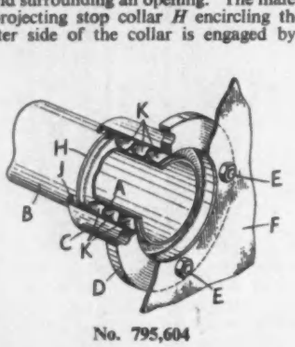

No. 796,182

the air cushions, without special intermediate components. According to the invention, the body A of a rail vehicle is supported at each end on a bogie *B* with two axles, as shown. Air cushions *C* are connected by support plates *D* to the vehicle body and the frame of the bogie. Four air cushions arranged in pairs on both sides of the longitudinal centreline of the vehicle are of cylindrical shape. The cushion height is greater than the largest diameter and is subdivided twice by means of annular devices. Modified designs are also shown in the specification.—*June* 4, 1958.

### PIPE COUPLINGS

**795,604.** November 2, 1956.—FLEXIBLE PIPE COUPLING, Kenneth William Jay, Orenda Engines, Ltd., of the Village of Malton, County of Peel, Province of Ontario, Canada.

In the drawing of the coupling is shown the end section *A* of a pipe *B*, the male part of the joint extends within a sleeve-like adaptor *C* which is of substantially greater diameter and forms the female part of the joint. The adaptor has an annular fastening flange *D* secured by bolts *E* to the wall *F* of a vessel and surrounding an opening. The male part *A* has a projecting stop collar *H* encircling the pipe. The outer side of the collar is engaged by a co-




No. 795,604

operating stop on the end of the female part, formed by turning-in the end of the adaptor *C* to produce an inner flange *J*. This arrangement prevents the parts from being drawn apart, but permits some relative axial movement and a relative angular movement. To seal the joints between the two parts and to constrain the relative movement between them, a number of annular diaphragms *K* of thin sheet metal or other resilient material span the space between them. The diaphragms are preferably of U-section to provide a dished annular surface that can be resiliently deflected and that will permit some axial and angular movement between the parts of the joint. The diaphragms are preferably brazed to produce a positive seal.—*May* 28, 1958.

## British Standards Institution

*All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.*

### METHOD OF TESTING VULCANISED RUBBER

No. 9032. Part D.6 : 1958—"Determination of indentation and recovery number of ebonite." Price 3s. The method specified in this standard is new to B.S. 903, in the sense that it did not form a part of the 1950 edition which is now in process of revision with each revised part being issued separately. It is based on the Rockwell method described in B.S. 891, but incorporates a different indentor.

Following a summary and explanatory note on the method are clauses specifying requirements for : test piece ; apparatus ; procedure ; temperature of test, and form in which report is to be stated.

### DRAWING BOARDS AND TEE SQUARES

No. 1265/68 : 1958. Price 5s. As top grade Honduras pine and yellow mahogany are no longer available in the large quantities required for the commercial production of standard quality drawing boards and tee squares a request was made by manufacturers for the revision of this specification, with its increased range of timbers whose suitability has been proven by experience gained during recent years.

Each standard in the new publication specifies the sizes, materials and constructional details of the appropriate product. There is a specified moisture content for the wood used for the drawing boards and the ebony edged tee squares ; and a detailed method for its determination is given in an appendix.

### INDUSTRIAL SAFETY HELMETS (LIGHT DUTY)

No. 2095 : 1958. Price 5s. Safety helmets conforming to this revised specification, as well as those made to the recently-issued B.S. 2826, concerned with heavy-duty helmets, are designed for the protection of workers engaged in structural engineering, shipbuilding, mining, quarrying and similar occupations in which there is a risk of injury from falling objects.

In addition to specifying requirements for construction and materials, the new B.S. 2095 contains details of the tests which light-weight helmets must undergo if they are to conform to the standard. The basic test assesses by a new method the shock-absorbing properties of a helmet. An 8 lb steel ball is dropped through 3ft 6in on to the crown of the helmet mounted on a headform. The unabsorbed energy transmits its force through another steel ball under the headform to a strip of aluminium. The indentation thus produced is a measure of the absorptive quality of the helmet. Other tests are for flammability, resistance to penetration by sharp objects, and electrical insulation (where this is required). Provision is made in the standard for the use by manufacturers of the B.S.I. certification mark.

### GLOSSARY OF TERMS RELATING TO POWDERS

No. 2955 : 1958. Price 4s. 6d. This standard defines a number of selected terms applicable to metallic and non-metallic powders. Powder is arbitrarily defined as "discrete particles of dry material of size less than 1000 microns maximum dimension." Sections of the publication contain terms associated with types of powder, particle size and shape and powder properties and processing.

Two appendices deal with "Mean diameters of particulate systems" and "Calculation of Stokes's diameter."

### CENTRIFUGALLY CAST (SPUN) IRON PRESSURE PIPES FOR WATER, GAS AND SEWAGE

No. 1211 : 1958. Price 6s. This revised publication is one of a series of British Standards for cast iron pipes. It deals with centrifugally cast (spun) iron pressure pipes of water, gas and sewage, manufactured in either metal or sand moulds. The "General" section specifies requirements for the quality of metal, quality control, selection of test pieces by the purchaser, hydraulic tests, coating and permissible deviations in weight. In this section, special consideration has been given to the requirements for the socket design and the coating in order to avoid unduly restricting future manufacturing techniques. Sections two and three of the standard deal respectively with pipes cast in metal moulds and in sand moulds ; they deal principally with mechanical tests and with marking requirements. The standard concludes with tables specifying the various dimensions involved and the shape of the test piece required. The test pressures for hydraulic tests carried out at a manufacturer's works exceed those specified in the first edition of B.S. 1211 ; they are now acceptable to purchasers on the American continent. Throughout this publication the appropriate portions of the I.S.O. Recommendation on cast-iron pipes, special castings and cast-iron parts for pressure main lines have been taken into account.

## Launches and Trial Trips

CONSTANCE BOWATER, bulk cargo ship ; built by the Caledon Shipbuilding and Engineering Company, Ltd., for the Bowater Steamship Company, Ltd. ; length overall 326ft, breadth moulded 50ft, depth moulded 30ft ; clear holds, MacGregor hatch covers, derricks to lift 6 tons, electric winches ; three 180kW diesel-driven generators ; Denny-Sulzer mark 6.S.D. 60, two-cycle, single-acting diesel engine, 2700 b.h.p. Launch, April 2.

DENBY GRANGE, oil tanker ; built by Hawthorn Leslie (Shipbuilders), Ltd., for the Houlder Line Ltd. ; length overall 557ft, breadth moulded 72ft, depth moulded 39ft, deadweight 18,000 tons ; twenty-seven oil cargo tanks, one main cargo pump room, three cargo oil pumps and three stripping pumps ; two 550kW, 440V geared turbo-alternators ; one set of double reduction geared two-cylinder turbines developing 8250 s.h.p., two Foster-Wheeler "D" watertube boilers supply steam at 500 lb per square inch and 800 deg. Fah. Launch, April 2.

CIRCE, closed shelter deck cargo ship ; built by the Anciens Chantiers Dubigeon for the Société Navale Caennaise ; length between perpendiculars 301ft 10in, breadth moulded 47ft 5in, depth to shelter deck 28ft 6in, draught loaded 20ft 6in, deadweight 3000 tons, speed 18 knots ; four holds, MacGregor hatch covers ; two S.E.M.T.-Pielstick diesel engines, built by Chantiers de Bretagne, drive a single shaft through Vulcan reduction gear, 3550 h.p. Trial, April.

TIDECREST, cargo ship ; built by the Forges et Chantiers de la Mediterranée for the New Crest Shipping Company, of Nassau ; length between perpendiculars 442ft, breadth moulded 61ft 6in, depth to shelter deck 39ft 6in, load draught 26ft 6in (open shelter), 30ft (closed shelter), corresponding deadweight 10,500 tons and 12,500 tons ; five holds, one 50-ton one 40-ton and ten 10-ton derricks, service speed 15 knots ; F.C.M.-Sulzer diesel engine, 6300 b.h.p. at 125 r.p.m. Trial, April.

ISARA, oil tanker ; built by the Chantiers de l'Atlantique Penhoët-Loire for the Compagnie Maritime Shell ; length between perpendiculars 631ft, breadth 86ft 9in, depth 45ft, deadweight 31,500 tons ; thirty oil cargo compartments, three 1300 tons per hour vertical centrifugal cargo pumps ; two 550kW turbo-alternators, one 150kW diesel-driven alternator ; one set of C.E.M.-Parsons double reduction geared turbines, 15,000 s.h.p., steam supplied at 640 lb per square inch and 840 deg. Fah. by two P.41 Penhoët watertube boilers. Trial, April.

## Forthcoming Engagements

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

#### ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

*Wed., June* 25.—BRIGHTON, HOVE AND DISTRICT BRANCH : New Imperial Hotel, First Avenue, Hove, Annual General Meeting, 6.45 p.m.

*Thurs., June* 26.—SOUTH LONDON BRANCH : Greyhound Hotel, High Street, Croydon, Annual General Meeting, 7.15 p.m.

*Sat., June* 28.—SOUTH WALES BRANCH : Angel Hotel, Westgate Street, Cardiff, Annual General Meeting, 7 p.m.

#### INSTITUTION OF CHEMICAL ENGINEERS

*Tues. to Thurs., June* 24 *to* 26.—Olympia, London, W.14, 17th Meeting of the European Federation of Chemical Engineering, Joint Symposium on "The Organisation of Chemical Engineering Projects."

#### INSTITUTION OF CIVIL ENGINEERS

*Thurs., June* 26.—Great George Street, Westminster, London, S.W.1, Conversazione, 5.30 p.m.

#### INSTITUTION OF ELECTRICAL ENGINEERS

*Wed., June* 25.—Royal Festival Hall, London, S.E.1, Conversazione, 7.30 p.m.

#### INSTITUTION OF MECHANICAL ENGINEERS

*Wed., June* 25.—SOUTHERN BRANCH : Visit to Armstrong-Vickers (Aircraft), Ltd., Hurn Airport, Christchurch, 2 p.m.

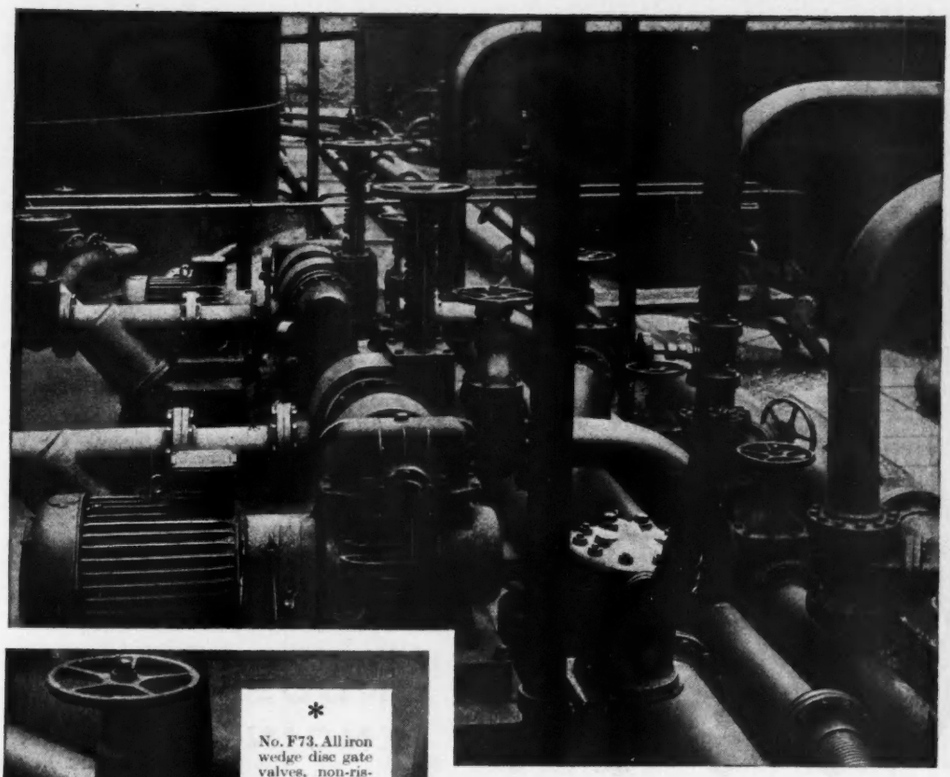
#### ROYAL SOCIETY

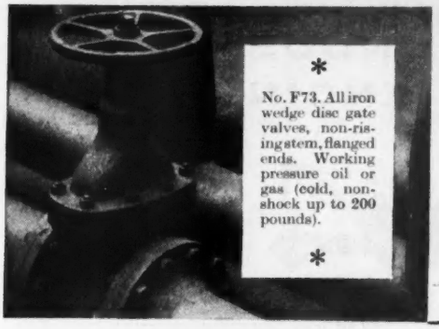
*Thurs., June* 26.—Burlington House, Piccadilly, London, W.1, Conversazione, 8.30 p.m.

## Advanced Engineering Courses

**Applications of Computers.** THE UNIVERSITY OF NOTTINGHAM, DEPARTMENT OF MECHANICAL ENGINEERING, University Park, Nottingham. One week's residential course, Monday to Friday, September 15 to 19. Course, including notes, ten guineas. Accommodation, eight guineas.

**The Design of Industrial Experiments.** THE UNIVERSITY OF BIRMINGHAM, INSTITUTE FOR ENGINEERING PRODUCTION, "Southfield," 16, Norfolk Road, Edgbaston, Birmingham, 15. Residential executive course, Monday to Friday, June 30 to July 4. Fee thirty guineas.





*

No. F73. All iron wedge disc gate valves, non-rising stem, flanged ends. Working pressure oil or gas (cold, non-shock up to 200 pounds).

*

# Once again, valves by Crane

At the tar works of the South Eastern Gas Board are six, one million gallon tanks used for the storage of crude tar and its products. Here is shown a twin-pump unit coupled through Crane valves to 'the million gallon storage'. In fact all the materials which enter or leave these tanks pass through Crane valves — all iron wedge gate valves with non-rising stem. Yet another twin-pump unit in the same works handles refined tar through similar cast iron valves at about 180° F.; the same unit pumps Coal Tar Fuel to barges berthed at the Board's wharf on the Thames. Once again all valves function faultlessly—thanks to Crane!

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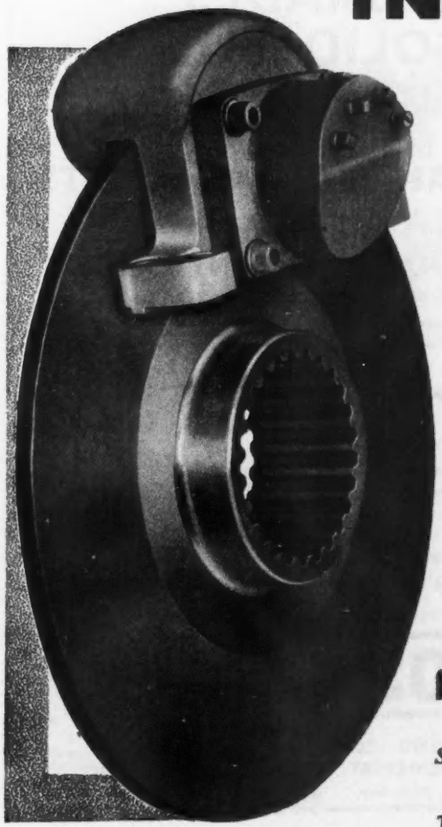
# SOLUTION TO TOUGHEST INDUSTRIAL BRAKING



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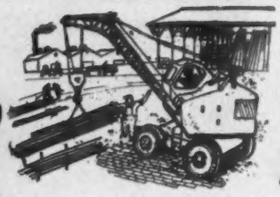

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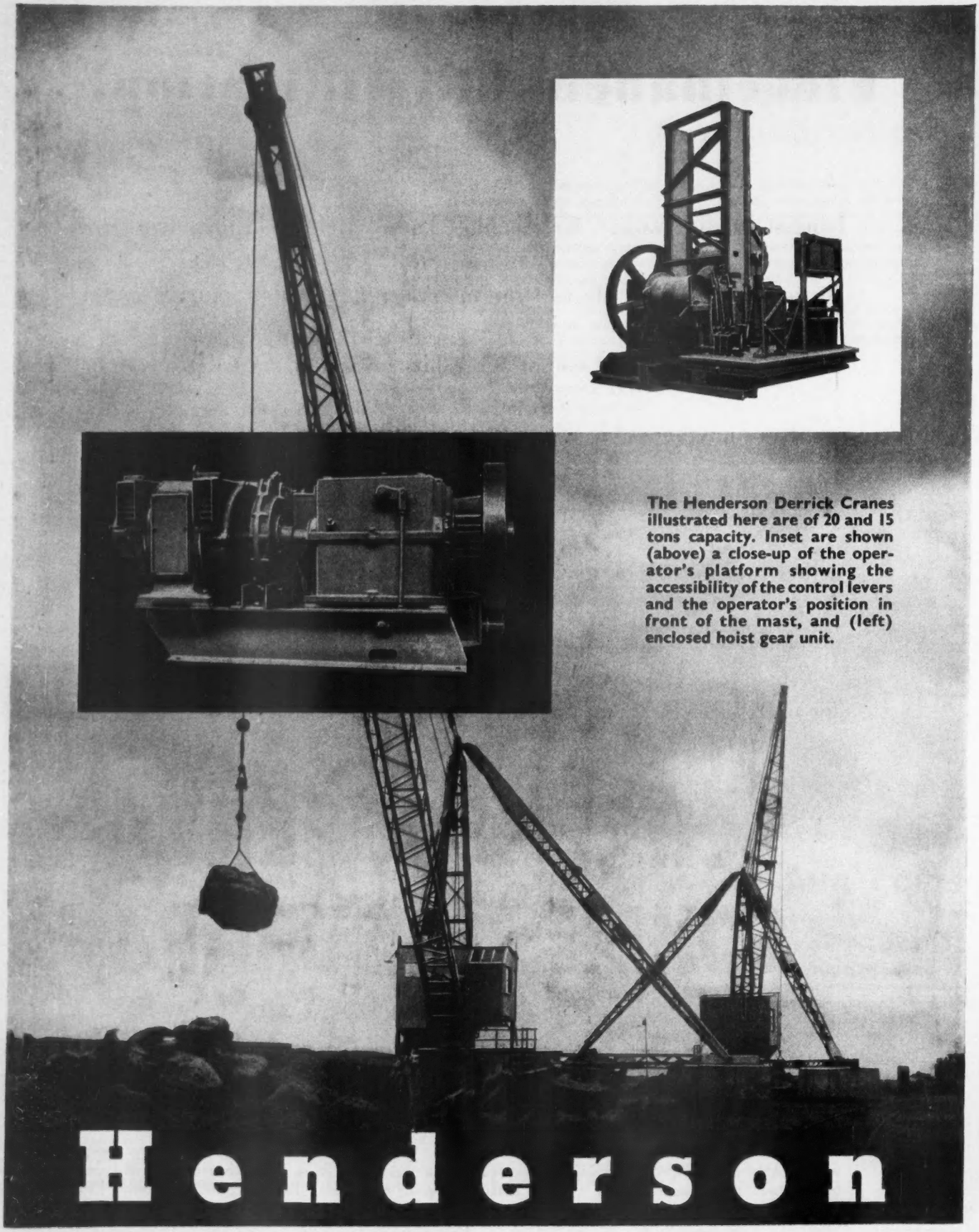

The Henderson Derrick Cranes illustrated here are of 20 and 15 tons capacity. Inset are shown (above) a close-up of the operator's platform showing the accessibility of the control levers and the operator's position in front of the mast, and (left) enclosed hoist gear unit.

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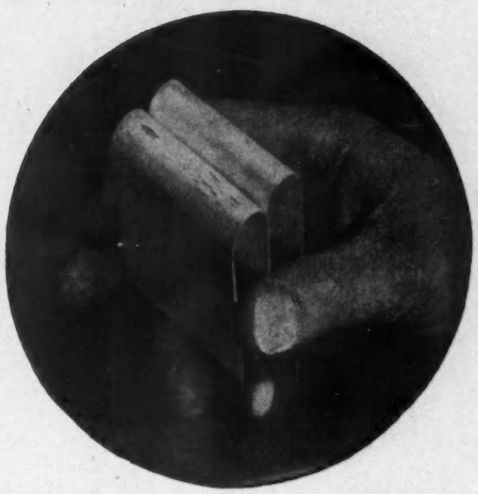

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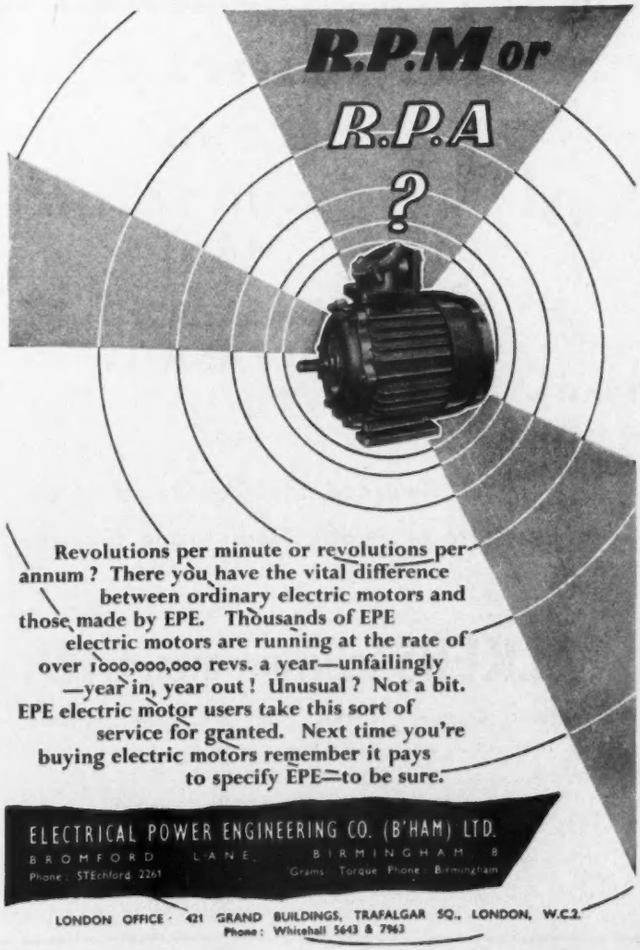


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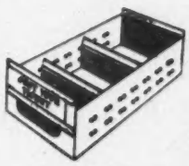

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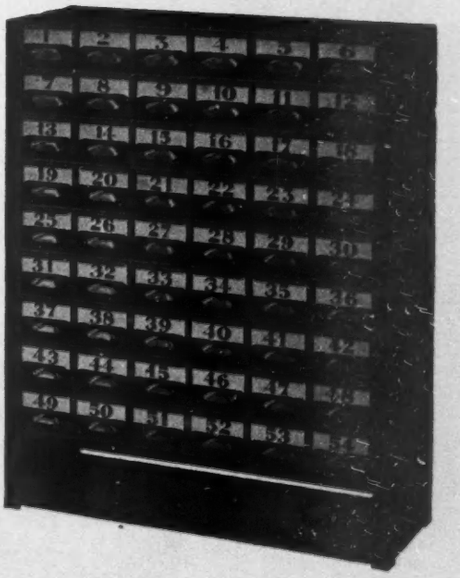

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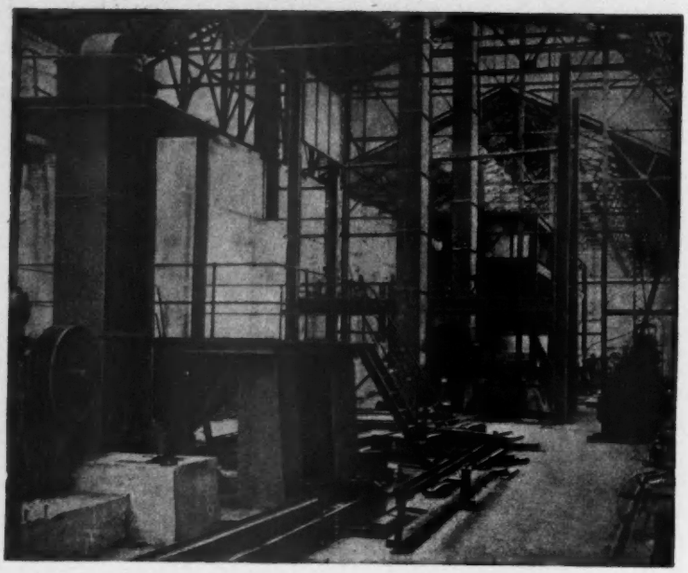

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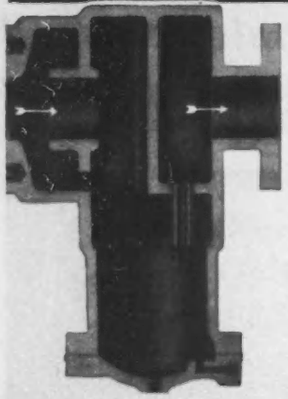

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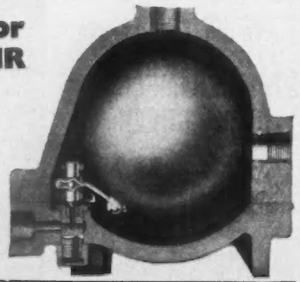

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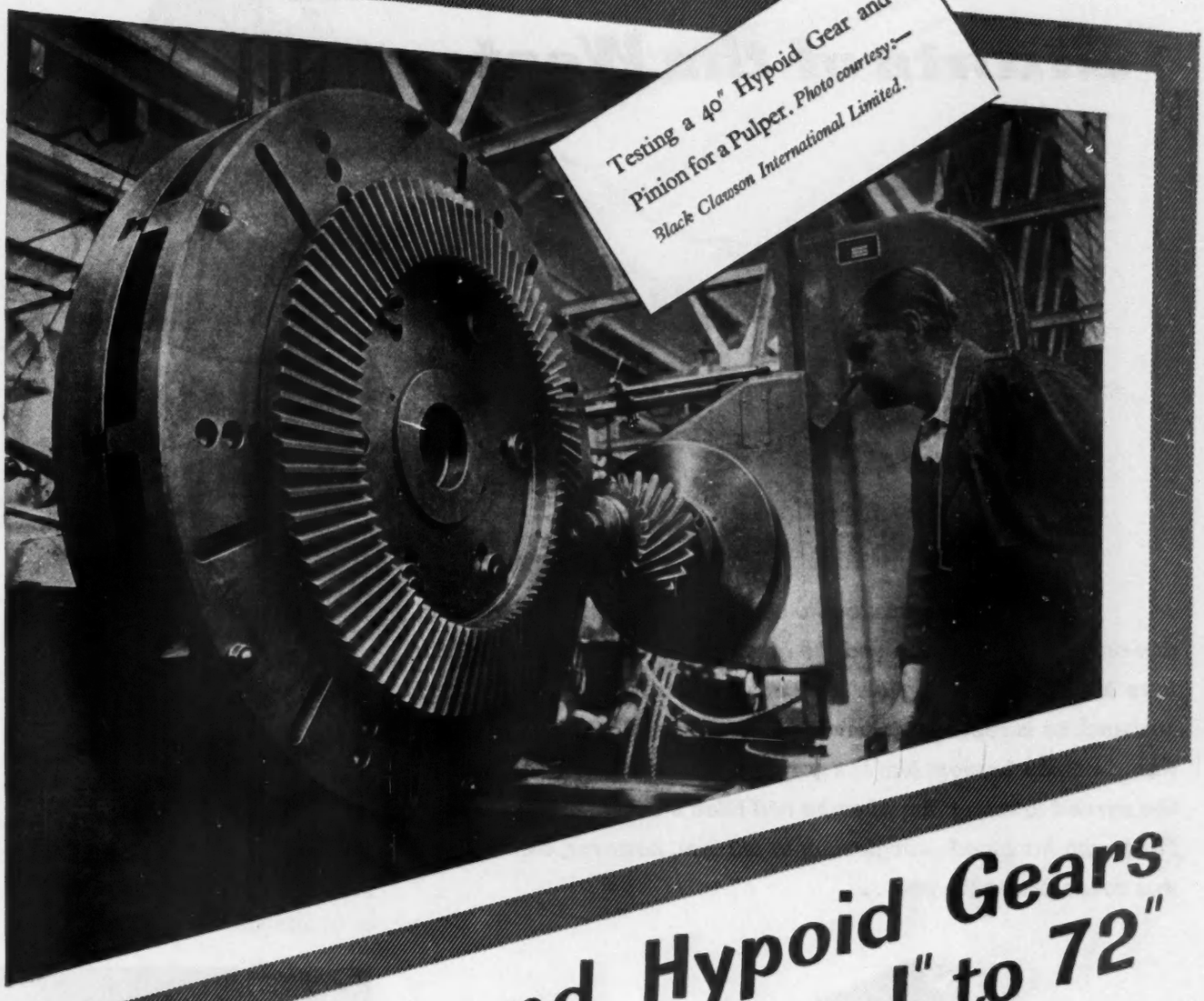

Testing a 40" Hypoid Gear and Pinion for a Pulper. *Photo courtesy:— Black Clawson International Limited.*

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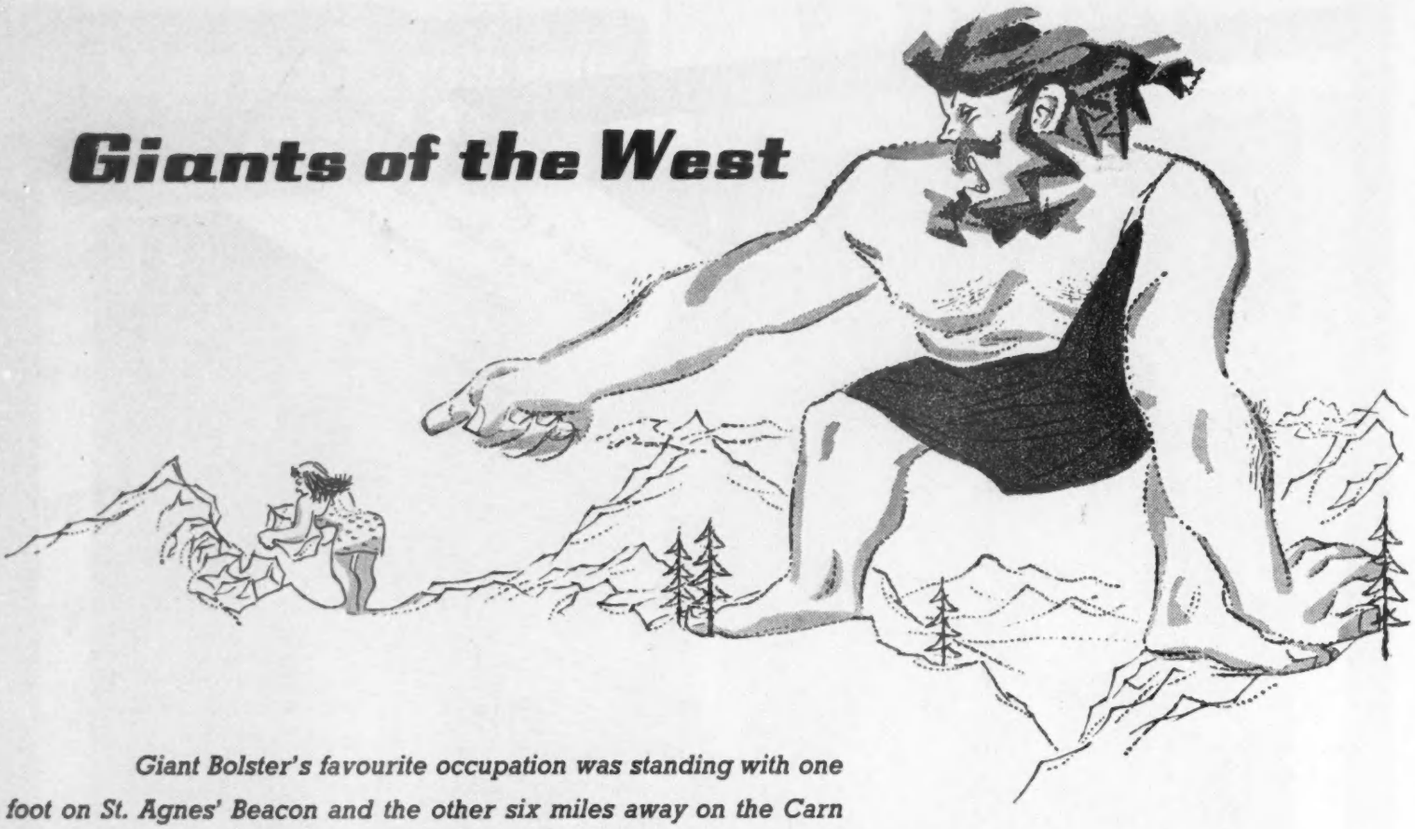
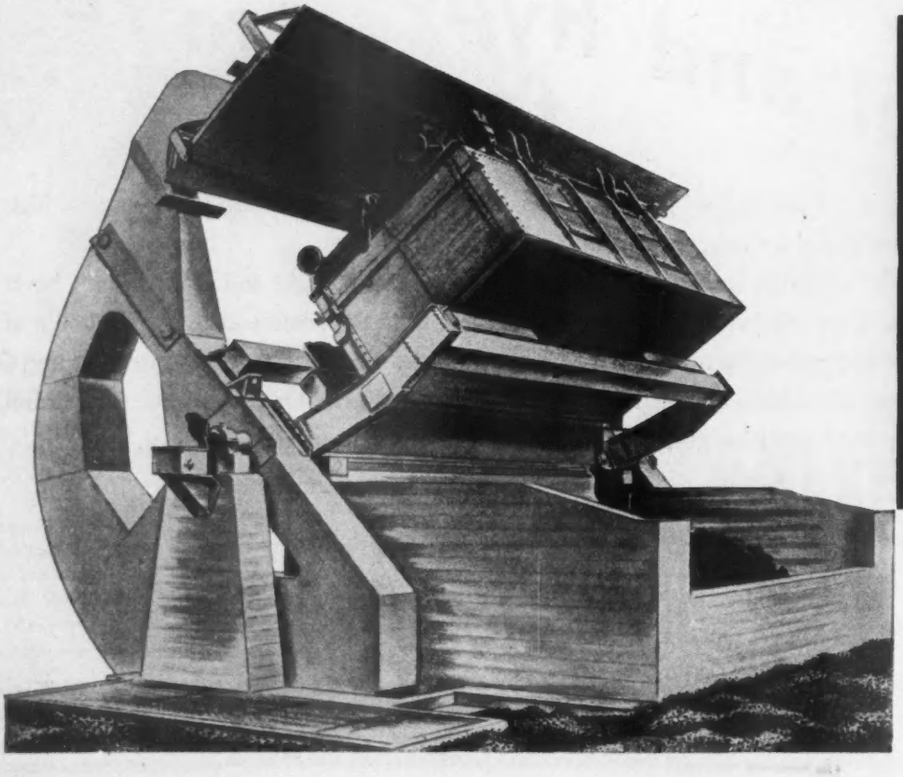
# Giants of the West



*Giant Bolster's favourite occupation was standing with one foot on St. Agnes' Beacon and the other six miles away on the Carn Brea hills, idly watching his wife quarrying granite. An imperfect husband, he is reported to have made a pass at St. Agnes herself—who promptly brought him to a gory end by a most unsaint-like trick. She agreed to marry him when he had filled a hole in a cliff at Chapel Porth with his blood—neglecting to tell him, however, that the hole was connected to the sea . . .*

It would be interesting to have Bolster's opinion of modern giants of the West—like the S & H wagon tipplers—which patiently perform herculean labours with no trouble at all, domestic or otherwise.



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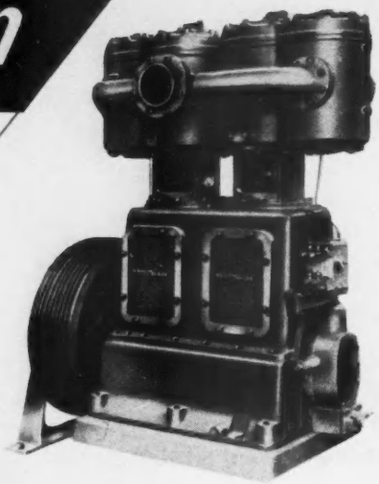

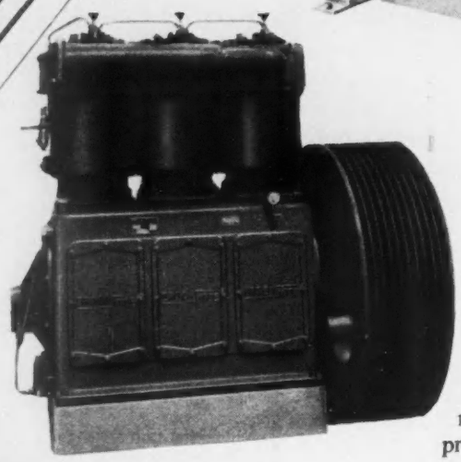

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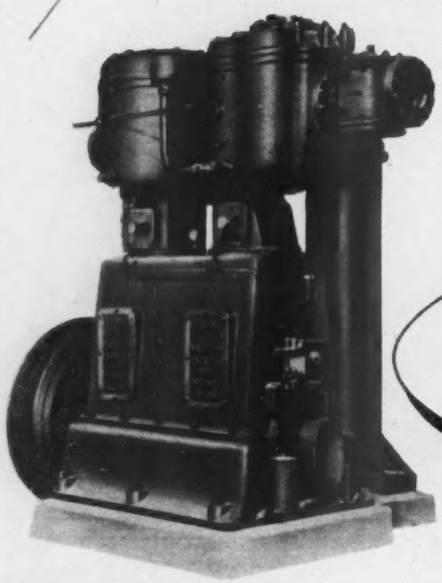

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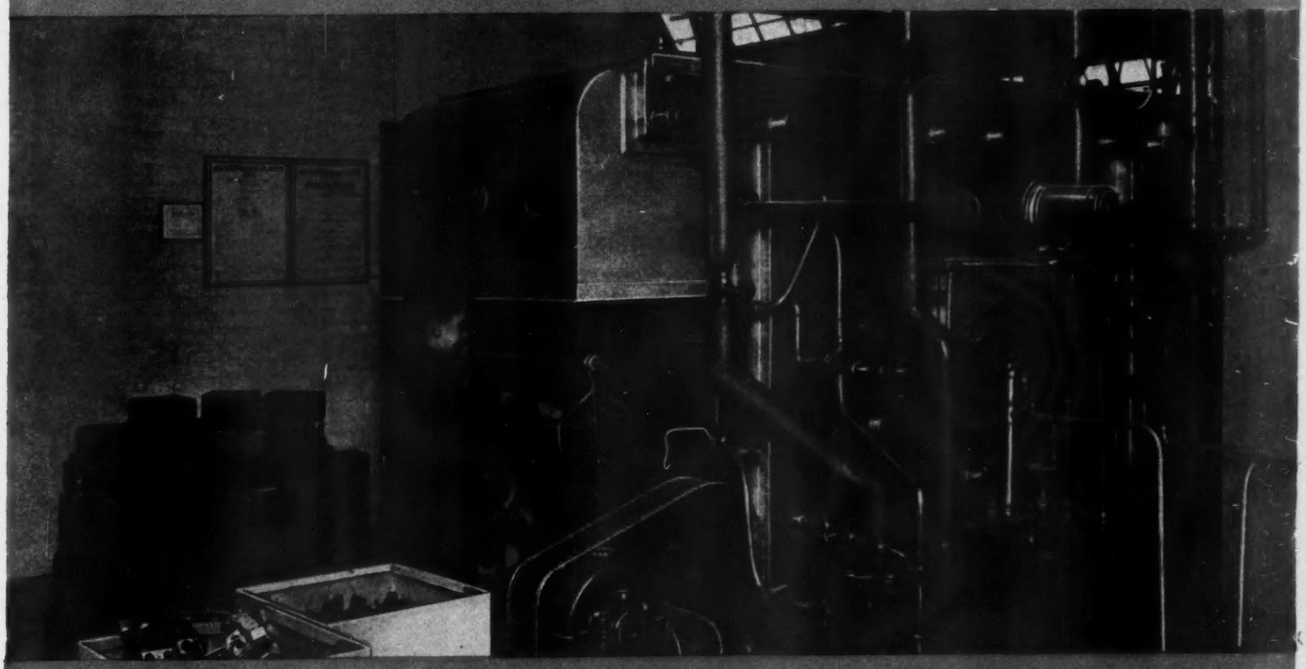

*The original plant in service*

**1952** A second plant was installed. Apart from a few minor modifications, this plant was similar to the earlier one.

**1955** After 20 years' continuous service, the first plant was replaced by another plant, identical to that supplied in 1952.

*The two later plants in service*

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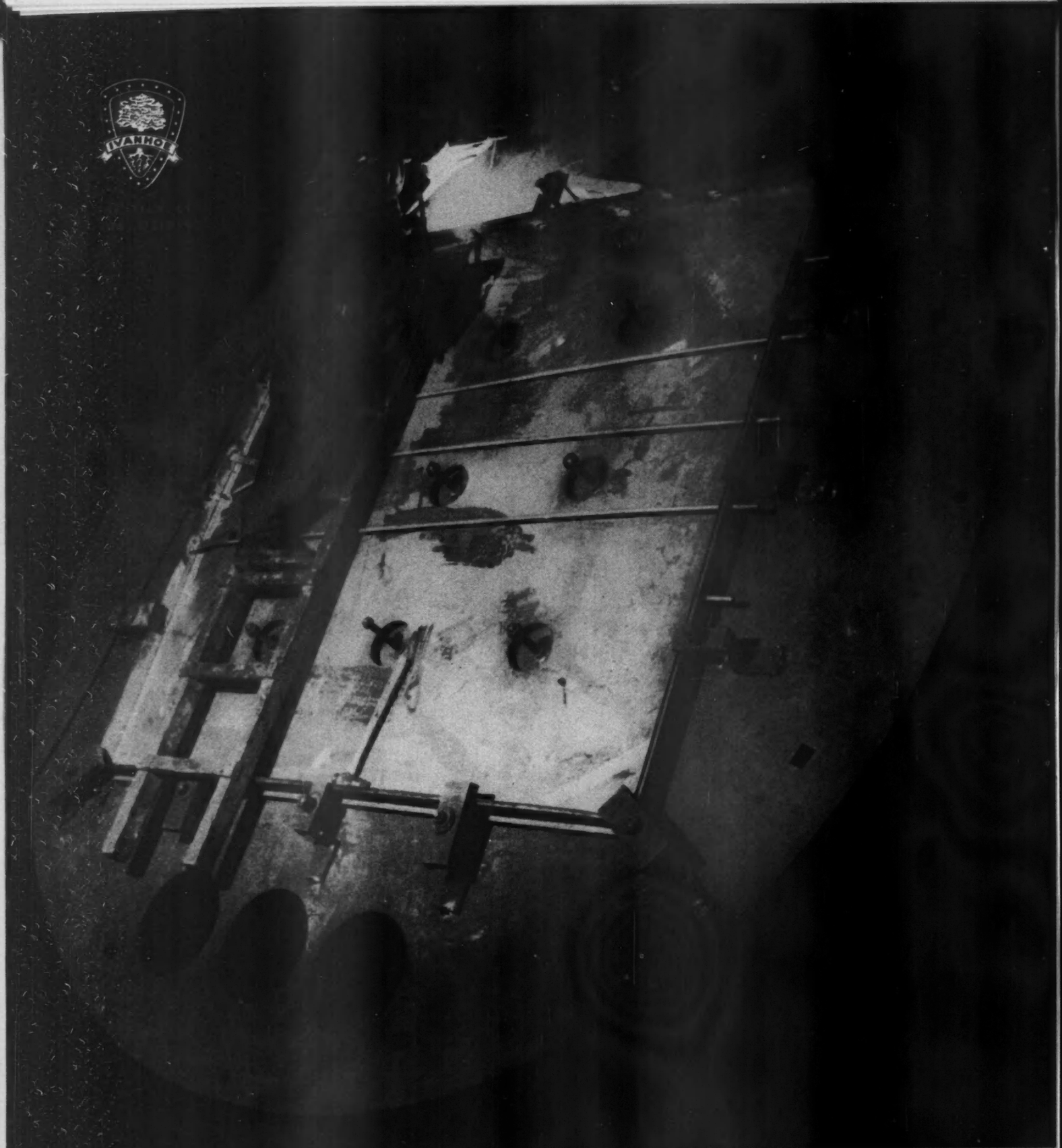

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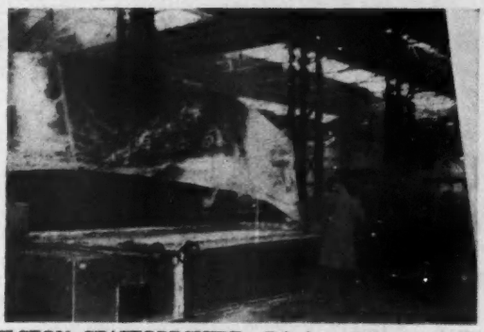
2 *Starting up with 30% virgin zinc and 70% molten zinc pumped from existing bath.*



3 *Completed galvanizing furnace showing specimen after dipping.*

4 *Oil storage equipment comprising 2–10,000 gal. storage tanks, heater, filters and pump.*

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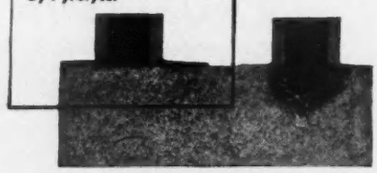
*Surface of firebrick protected from slag attack by Pyrolyte.*



Pyrolyte provides an excellent protective wash for firebrick work. Illustration shows a firebrick partly treated by a Pyrolyte wash and partly untreated. The absence of slag penetration on the treated surface indicates the high slag-resisting properties of Pyrolyte High Temperature Cement. (The brick was heated to a temperature of 1500/1550°C.)

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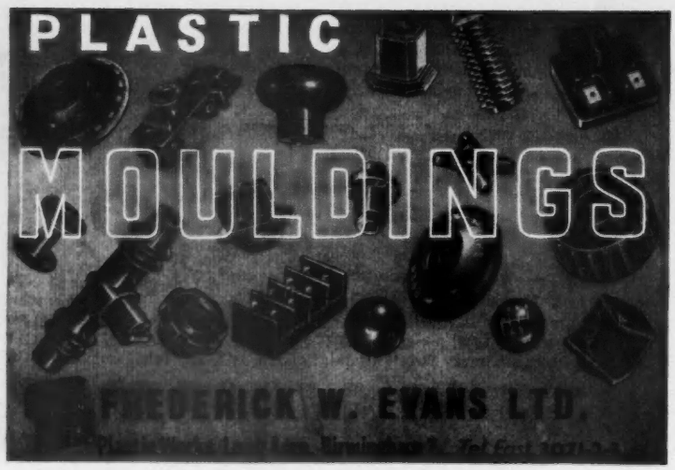

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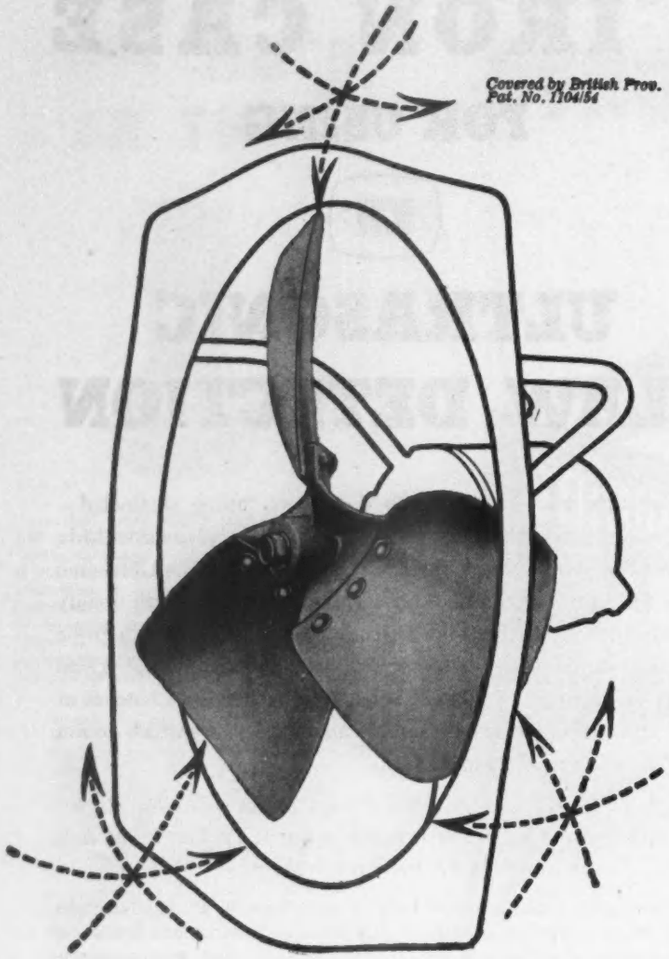


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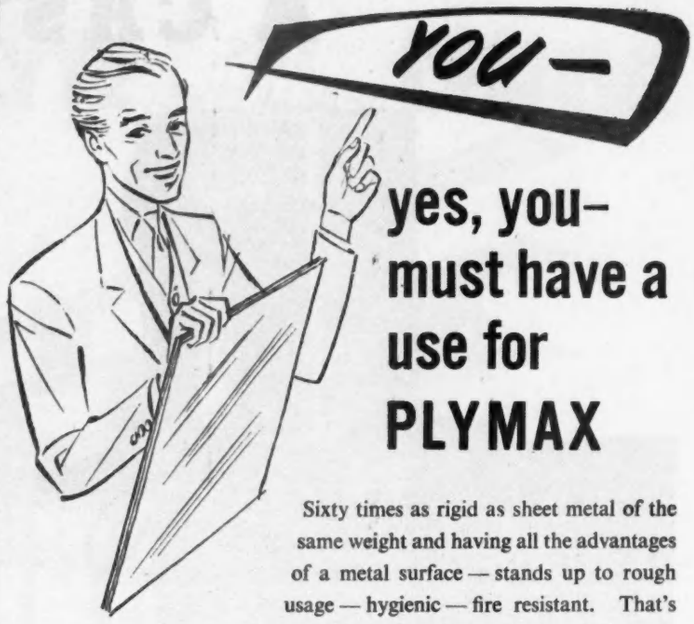


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PLYMAX has metal on one or both faces: it is available faced with aluminium or galvanised steel (other metals if required): it is manufactured in 40 standard sizes and in various thicknesses.

*Here are some examples of PLYMAX uses:*

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Casings
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# PLYMAX Regd.

the Venesta Metal-faced Plywood

*Write for samples and literature*

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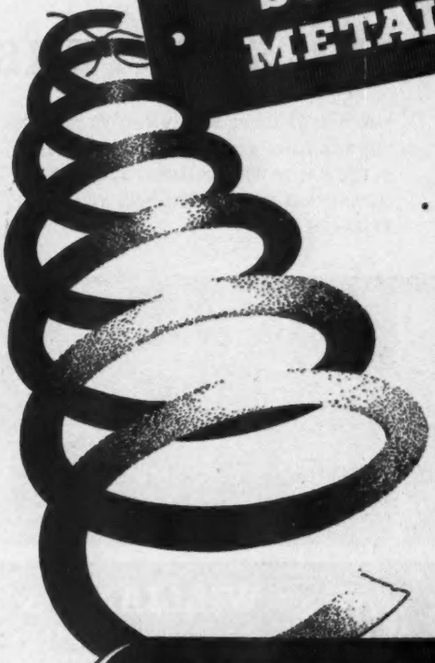
SCRAP METAL?



. . . then the name that SPRINGS to mind is . . .

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SCRAP METAL MERCHANTS & SUPPLIERS • STOCKHOLDERS OF STRUCTURAL STEEL

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**FREE ADVICE ON COLOUR**

*Write to the Permoglaze Decorative Advisory Service for expert advice on specifications and colour schemes.*

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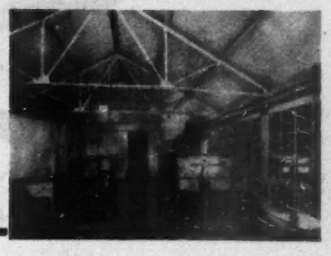
*A user writes :—*

"I used Permoglaze for a food processing room nine years ago. I have washed it many times and it is still as good as new."

*A Permoglazed Canteen.*



*Dairy Cooling Room treated with Permoglaze*

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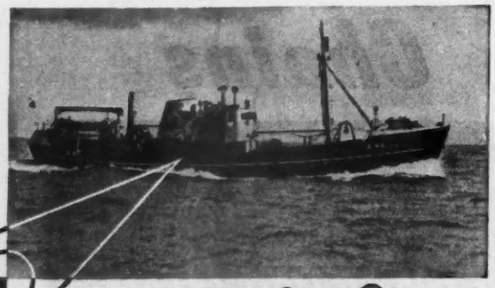

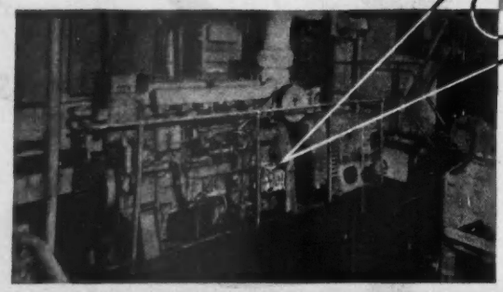

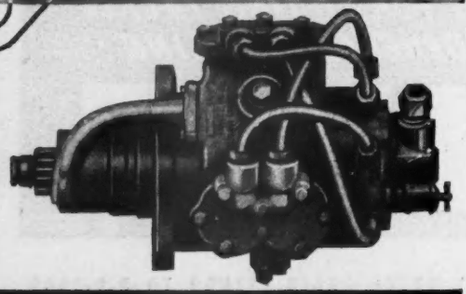

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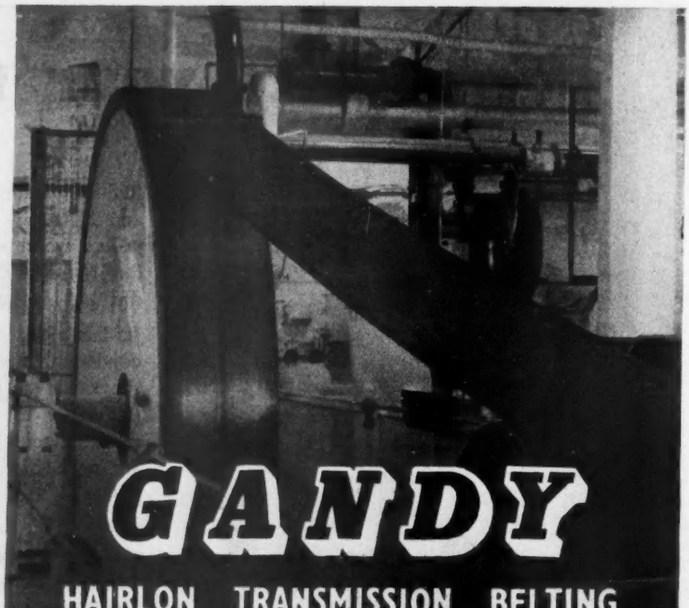

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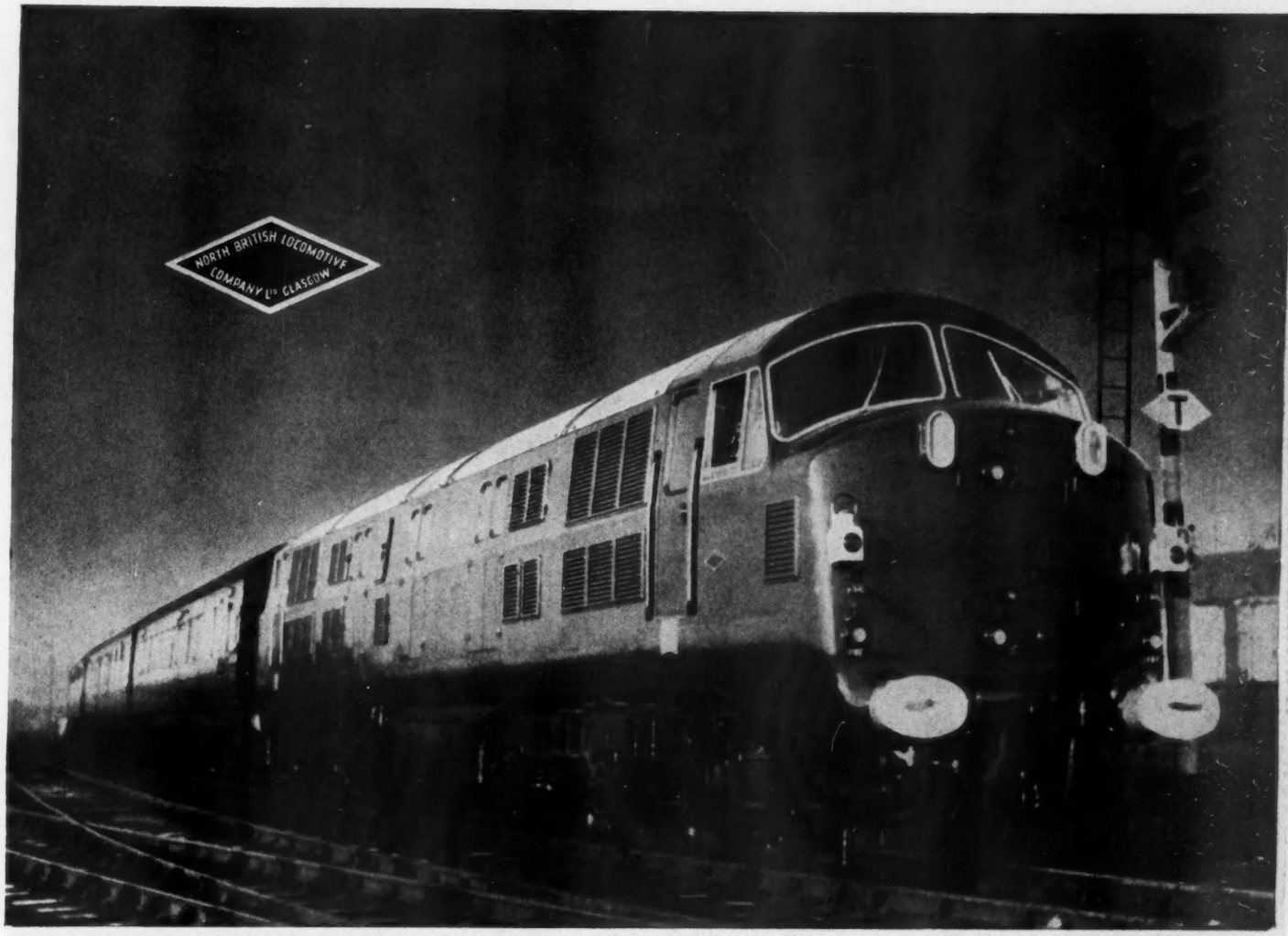


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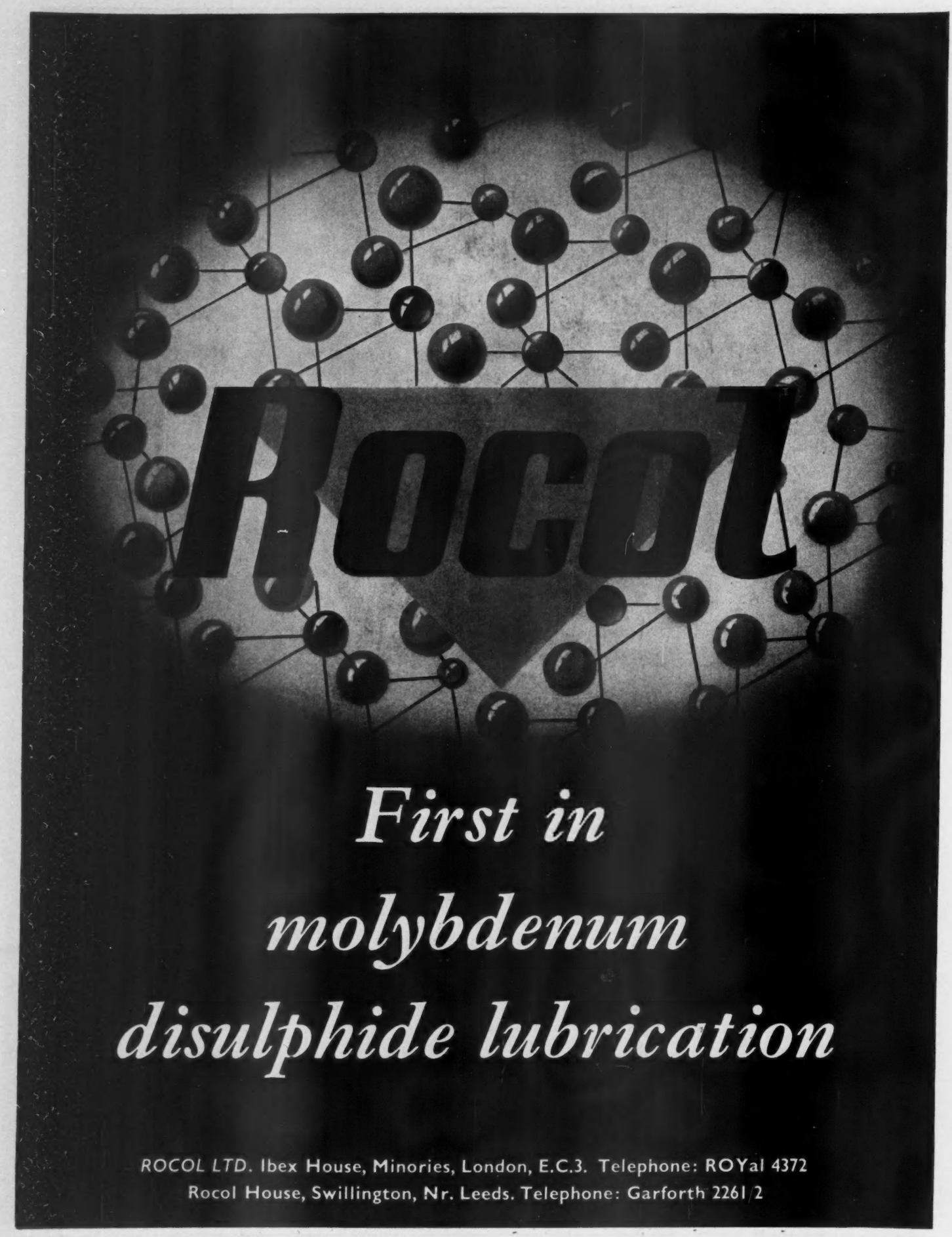
The Voith system of hydraulic transmission has been in continuous use and development over a period of 30 years and has been applied to locomotives and railcars of all types, all over the world.

# NORTH BRITISH

**Locomotive Co. Ltd. Glasgow**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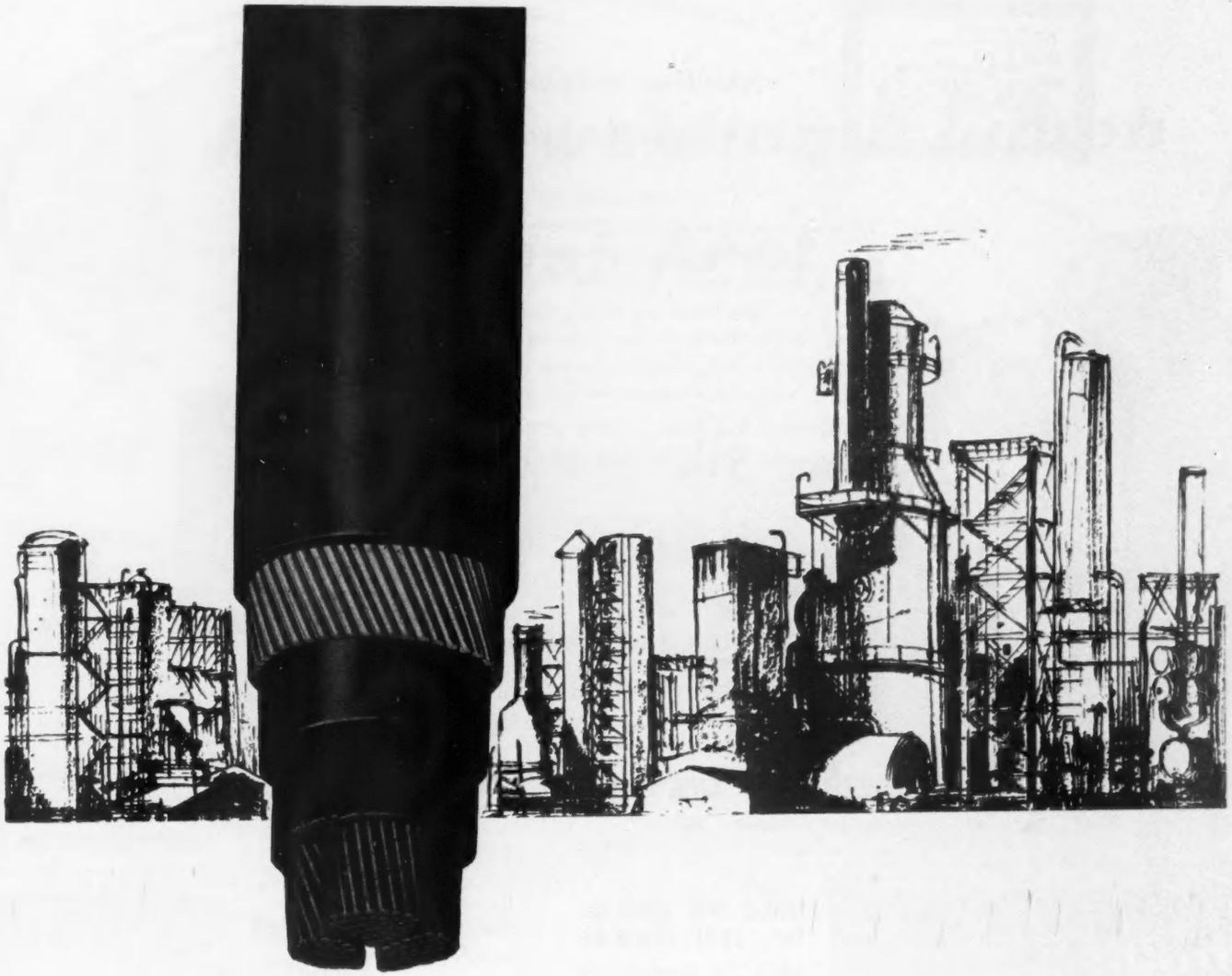

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In many industrial environments cables are subject to attack and damage by the corrosive conditions.

**BICC have the answer** !—*cables with extruded PVC oversheaths.*

These have been developed for use in oil refineries, chemical plants, laundries, distilleries and many other installations where ordinary types of serving do not give sufficient protection.

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BICC make PVC oversheathed Power Cables for every working voltage. Large industrial organizations already using them include the B.P. and Shell Companies, the National Coal Board and I.C.I.

**BICC** *PVC* **oversheathed cables**

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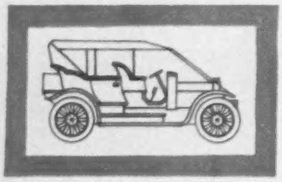

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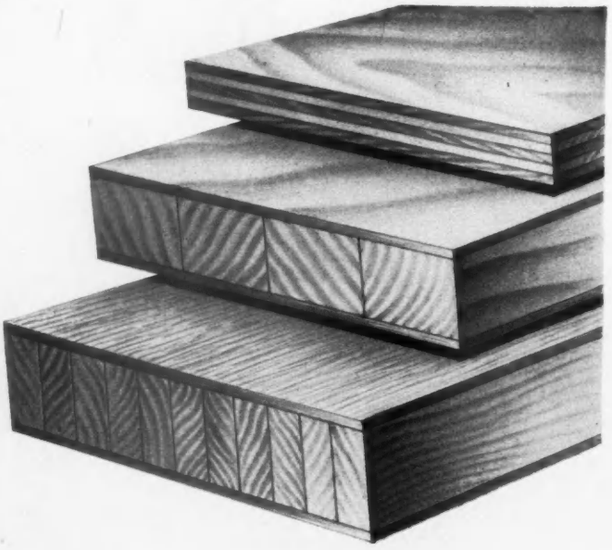

*Range of thicknesses*

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*from 1/16" to 1"*

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*from 16 m/m. to 25 m/m. (5/8" to 1")*

**LAMINBOARD**
*from 13 m/m. to 51 m/m. (1/2" to 2")*

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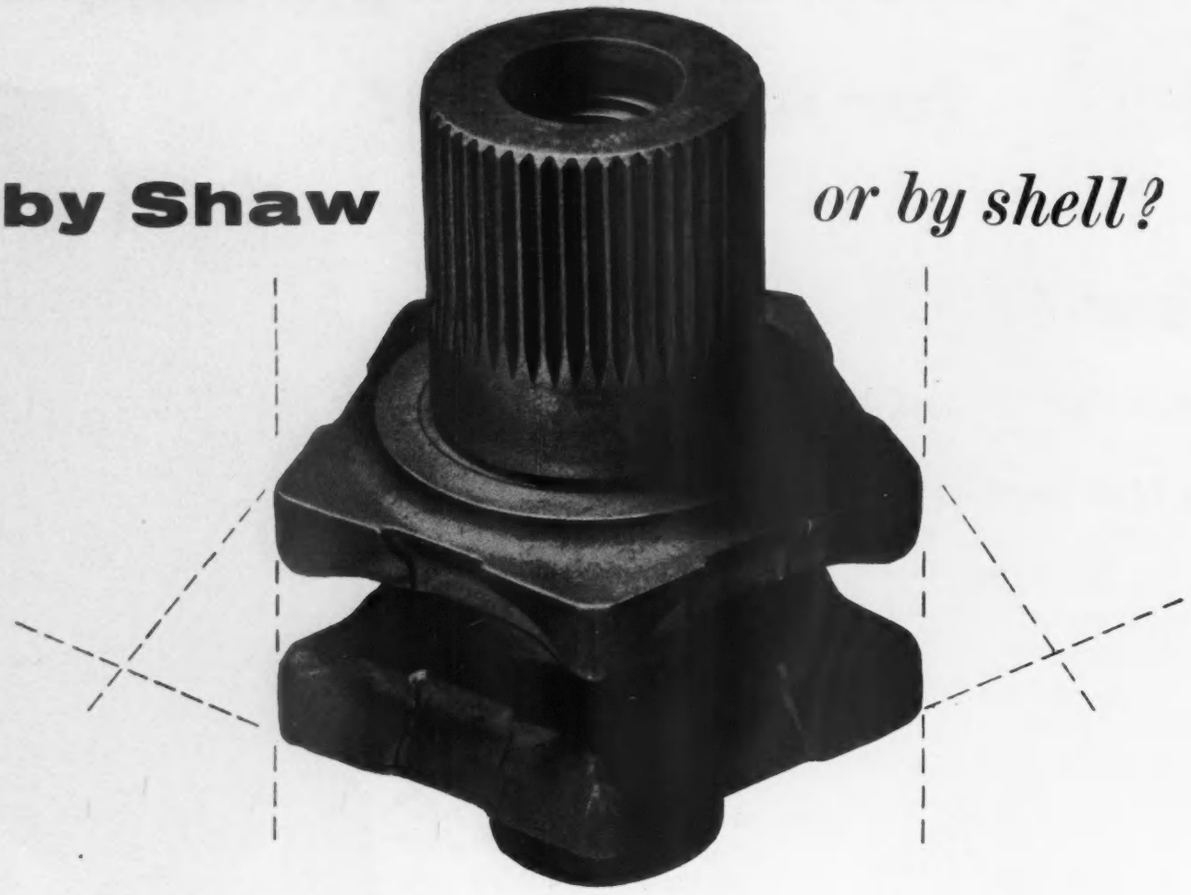
✳ *Available direct from Quasi-Arc Limited and also for argon shielded welding in the U.K. from their associates British Oxygen Gases Ltd.*

**For better welding and friendly service**

**QUASI-ARC**

QUASI-ARC LIMITED · BILSTON · STAFFORDSHIRE

# by Shaw *or by shell?*



As licensees of the Shaw Process, and producers of castings by the shell moulded process as well, The PHOSPHOR BRONZE Co. Ltd. can give you an unbiased opinion on the better method to use in any instance. While castings produced by the shell moulded process are more accurately produced than by older methods, the limits cannot be held to the same high degree of accuracy as when castings are produced by the Shaw Process. **When machining time and costs make the difference, P.B. technicians are ideally placed to help your own technicians to decide their choice.**

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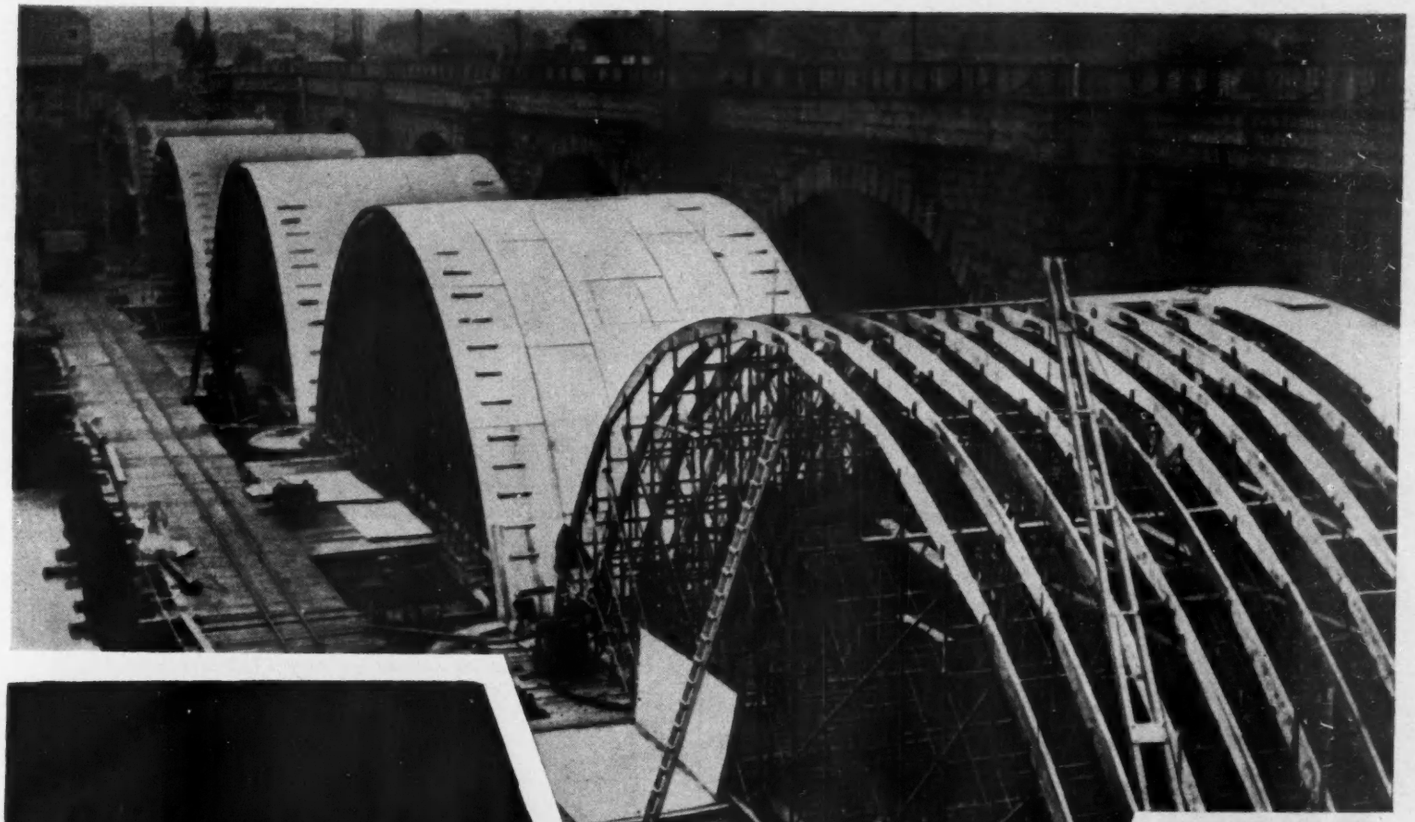

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2 Labour force of only five men on scaffolding (3 of which were unskilled).

3 Only Safway equipment used throughout.

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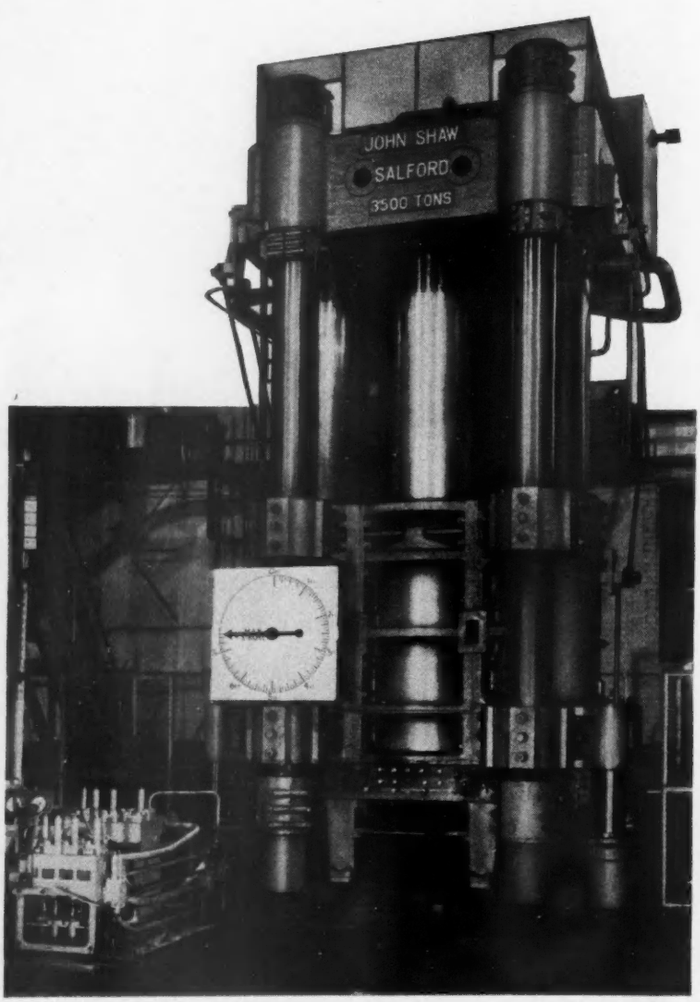
For whatever purpose you need a hydraulic press you will do well to consult JOHN SHAW.

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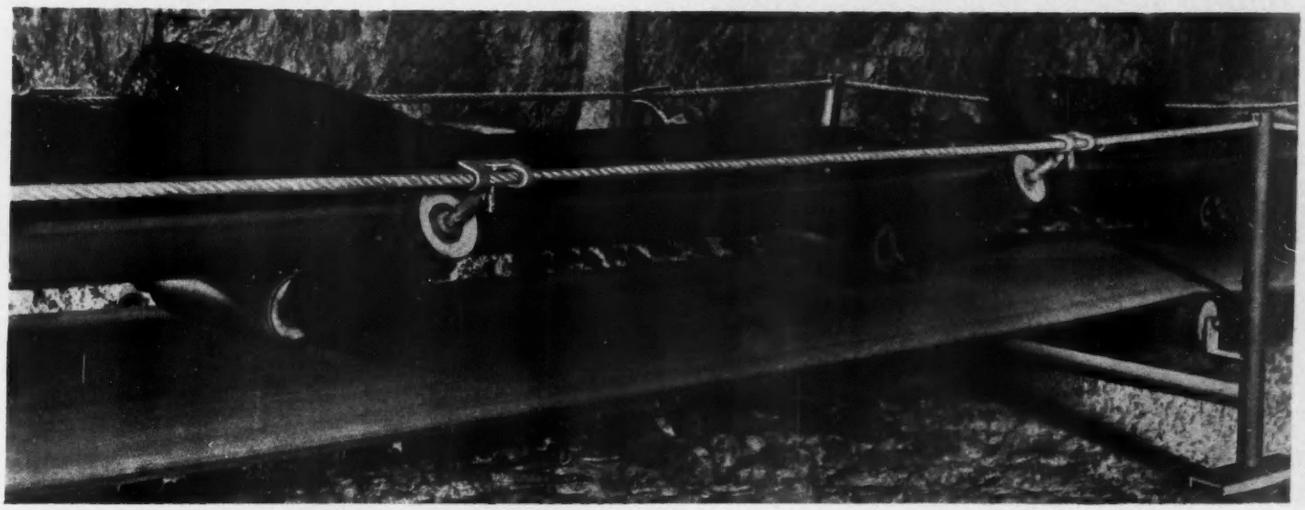

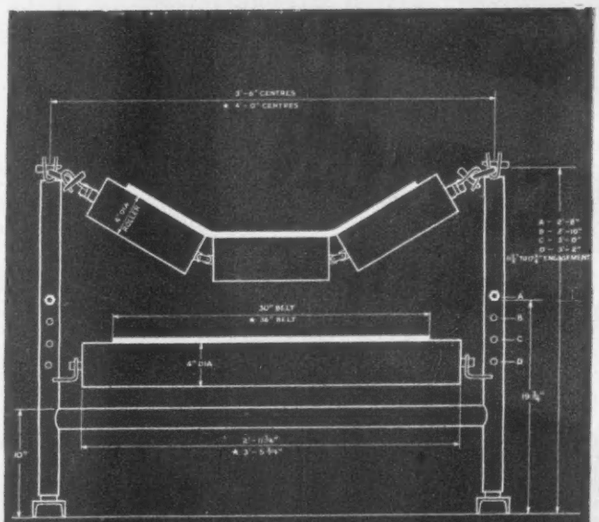

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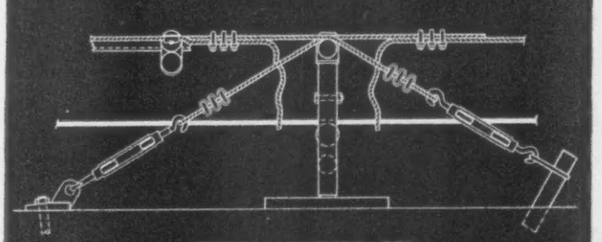
(Adjustable for height)



TYPICAL ANCHORAGES

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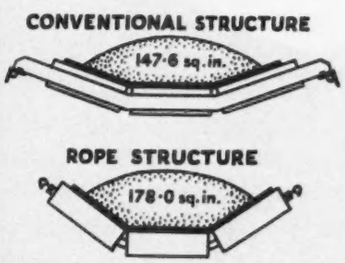
**Distington-Goodman**

# BELT CONVEYOR STRUCTURE

(Patented)

- ***increases belt life***
- ***reduces installation costs***
- ***increases capacity***
- ***almost eliminates spillage***
- ***inexpensive***




*Greater conveying capacity obtainable by increased troughing under load*

The longitudinal members of this conveyor structure consist of ⅜" dia. steel ropes in tension. The connections at the ends of each troughing idler shaft are hinged. These basic features provide a resilient conveyor which is easy to stack, transport and install — a conveyor in which impact damage to the belt as it passes over the idlers is greatly reduced. The belt is easy to train. The bottom belt is in full view and there need not be any concealed rubbing between belt and structure.

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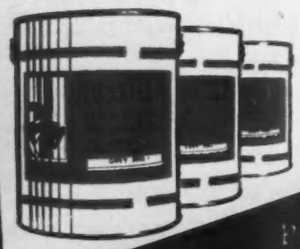

Practical experience dictates 3-coat treatment for the protection of new steelwork or where rusted metal must be bared. For your new constructions and for your maintenance programme, specify 'Atlas' Ruskilla' Paints throughout. Remember, every coat Primers, Undercoats and Finishes is truly rust inhibiting, durable and dependable! Send today for shade card to ATLAS PRESERVATIVE CO. LTD., ERITH, KENT. Telephone: ERITH 2255.

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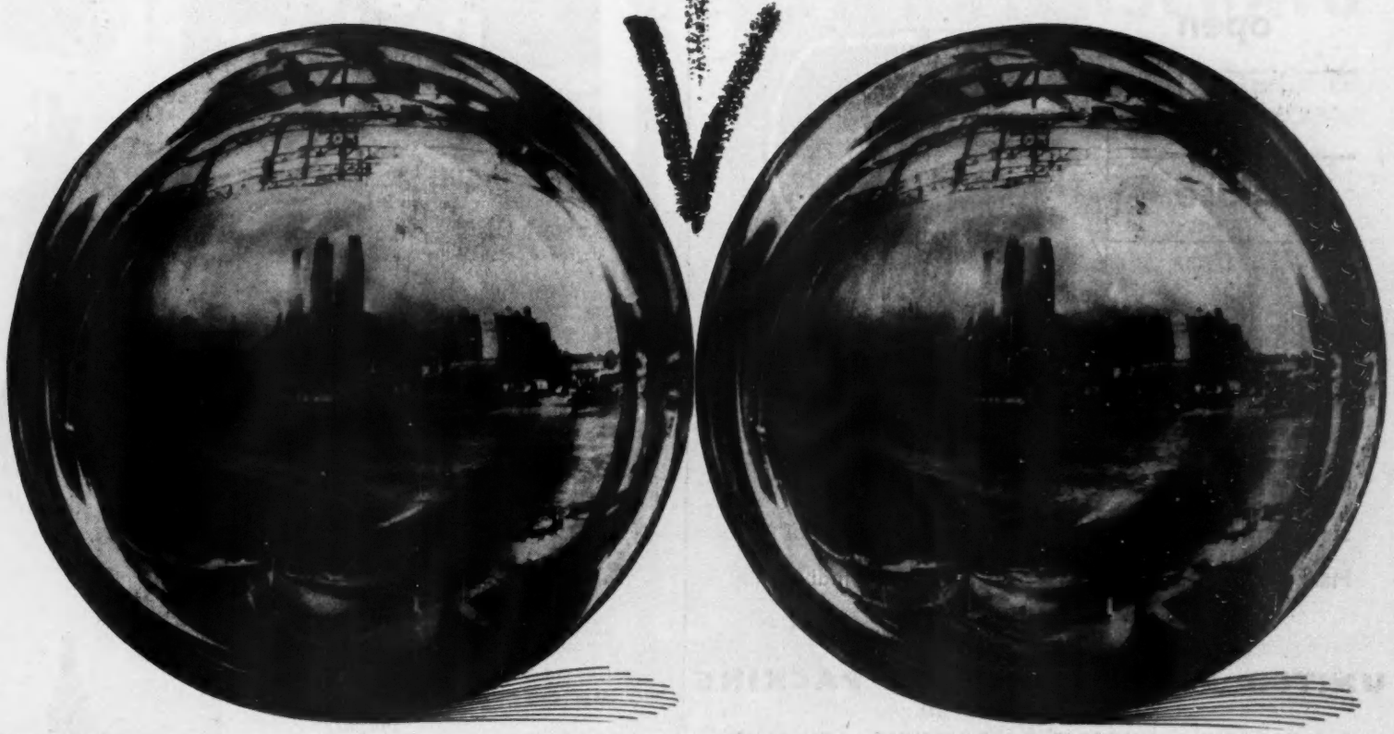

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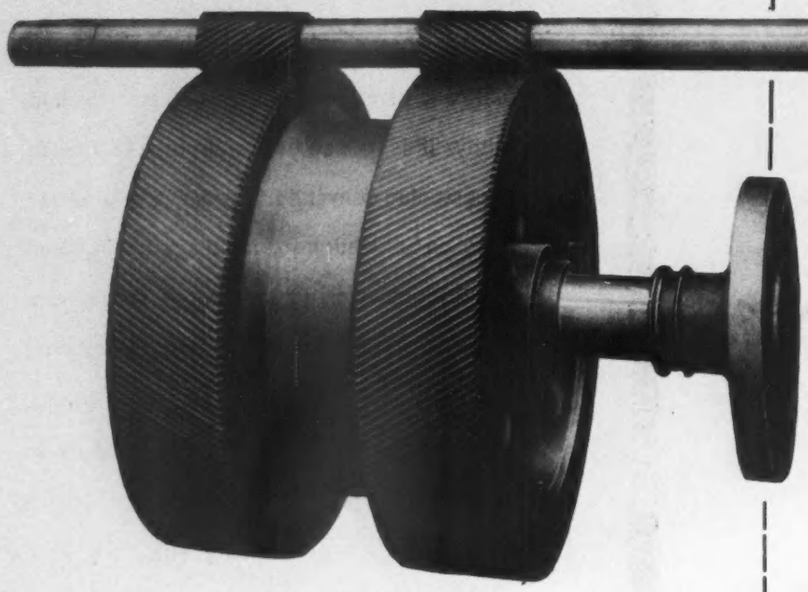

# Reid

Reid are completely equipped to produce all types of gears and drives. Gears up to 3000 h.p. and spiral bevels at 34" dia and over give some indication of the resources at the *Linwood* factory of *Reid.*

*We can now quote quick delivery of all gear units. Write, or 'phone Johnstone 861 for full details.*

*ENQUIRIES ARE WELCOMED FOR ALL TYPES OF GEAR CUTTING AND SPECIAL MACHINE GEAR DRIVE MACHINING.*

**Reid** *Every Type—Every Size—Every Need.*

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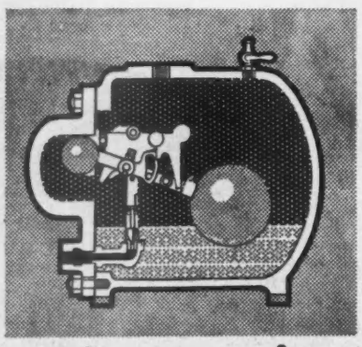
# BRADFORD Steam Traps

open

and

close



*instantaneously*

This instantaneous action distinguishes the Bradford Steam Trap from all its competitors. It prevents damage to valves and seats. It provides more efficient use of steam and heat, thus making an appreciable saving of fuel. Made in all sizes for all pressures. Each Trap is individually tested and fully guaranteed.

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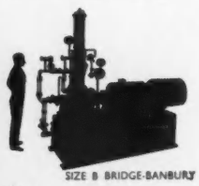

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**Highest Output** more quickly, more efficiently, and guarantee a more uniform and **Highest Quality** mix. By minimising manual operating they produce at **Lowest Costs** with the maximum degree of dependability and safety.

*Consult our engineering service on layouts and machines for rubber and plastics. Our catalogue BB200 is yours for the asking.*

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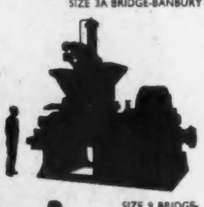
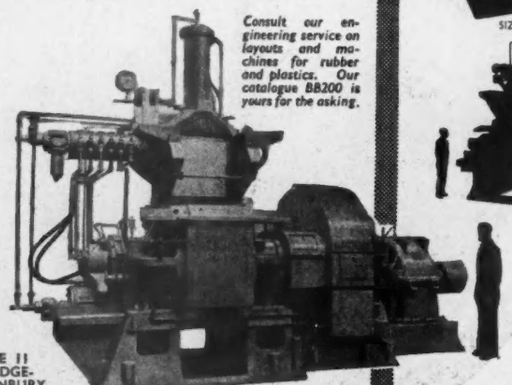


SIZE 9 BRIDGE-BANBURY



SIZE 11 BRIDGE-BANBURY

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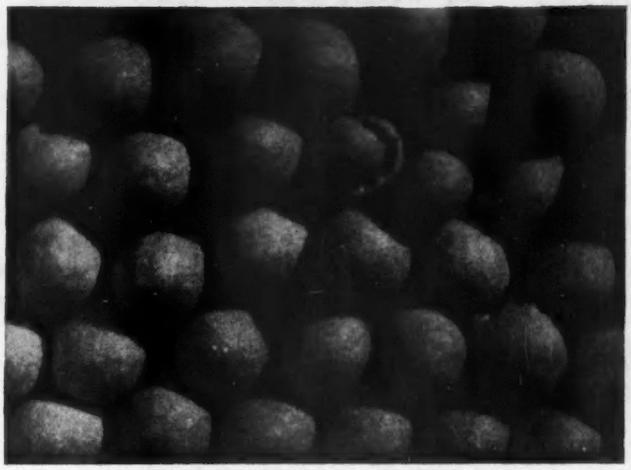

that this picture shows a clutch of turtles' eggs? Maybe you're not too sure.*

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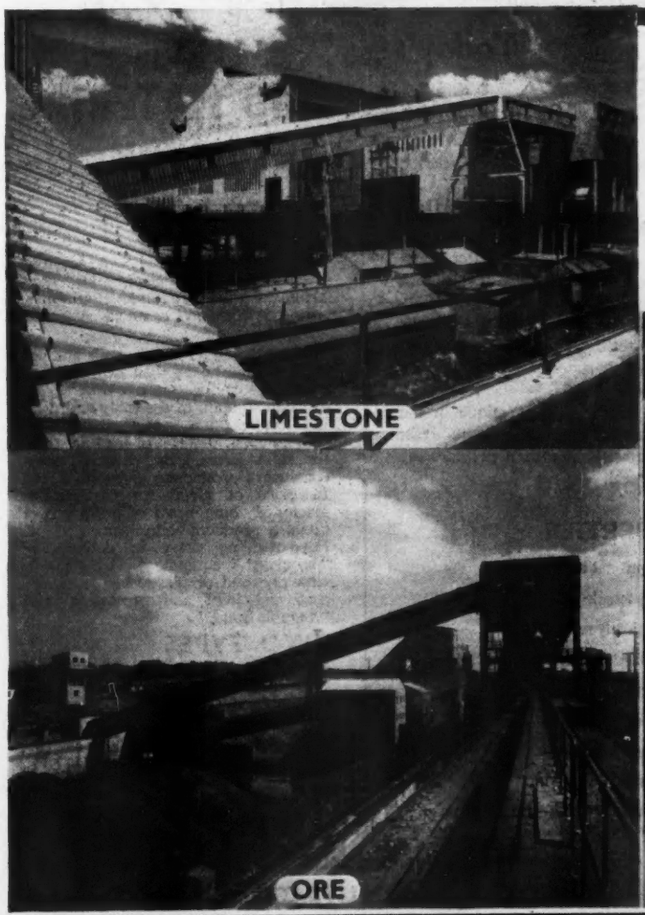


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*This illustration shows size variation between Thorn Pygmy and a comparable AN Connector*

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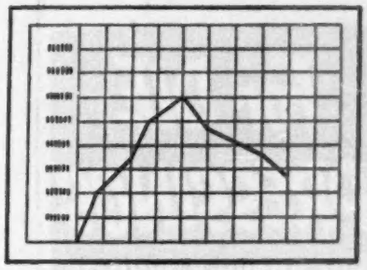

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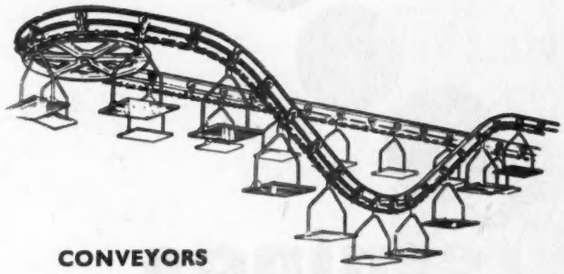
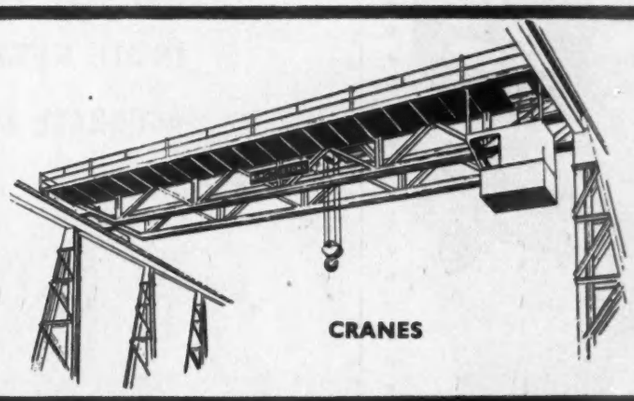


CONVEYORS



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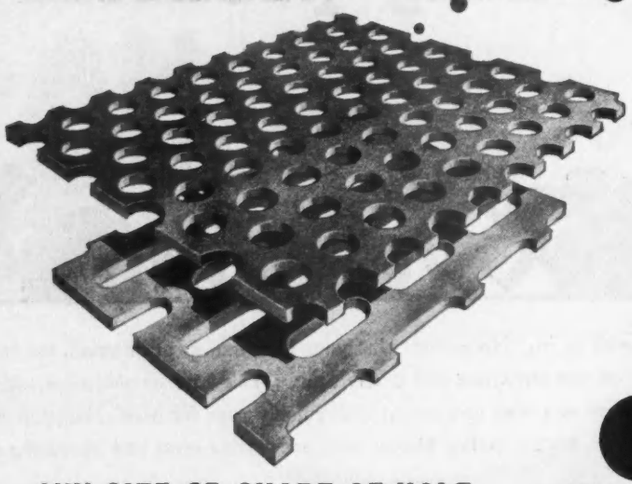

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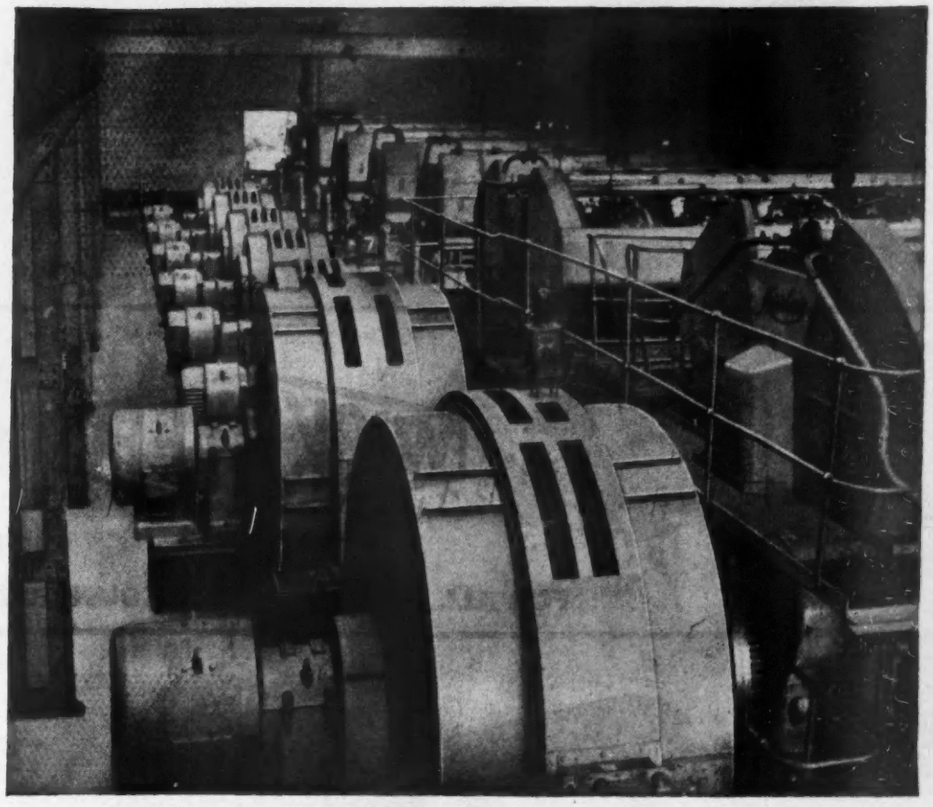

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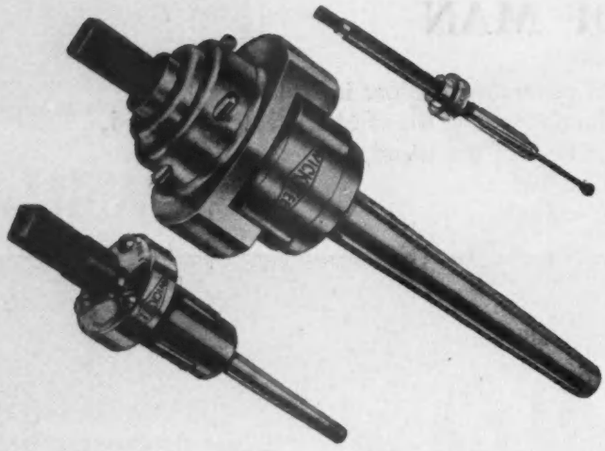

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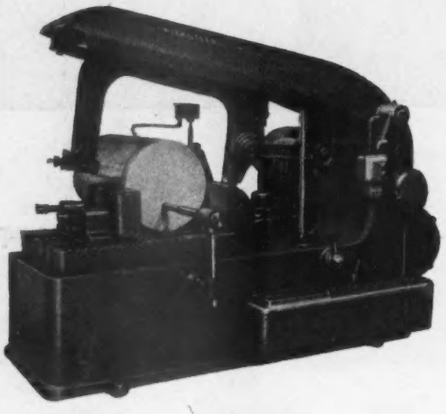

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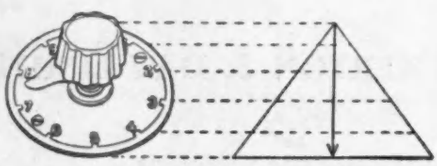

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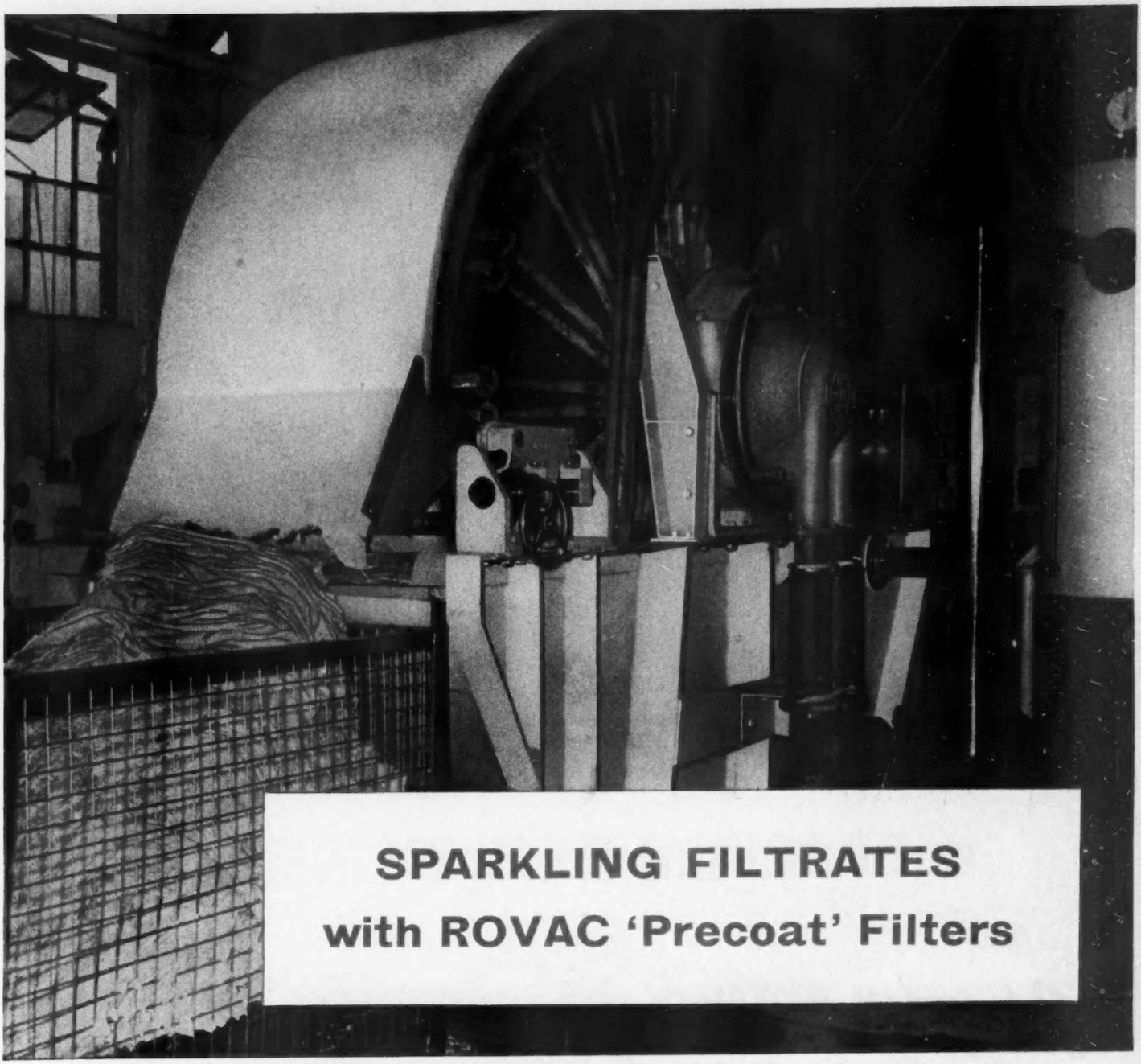

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High Voltage
Testing Equipment
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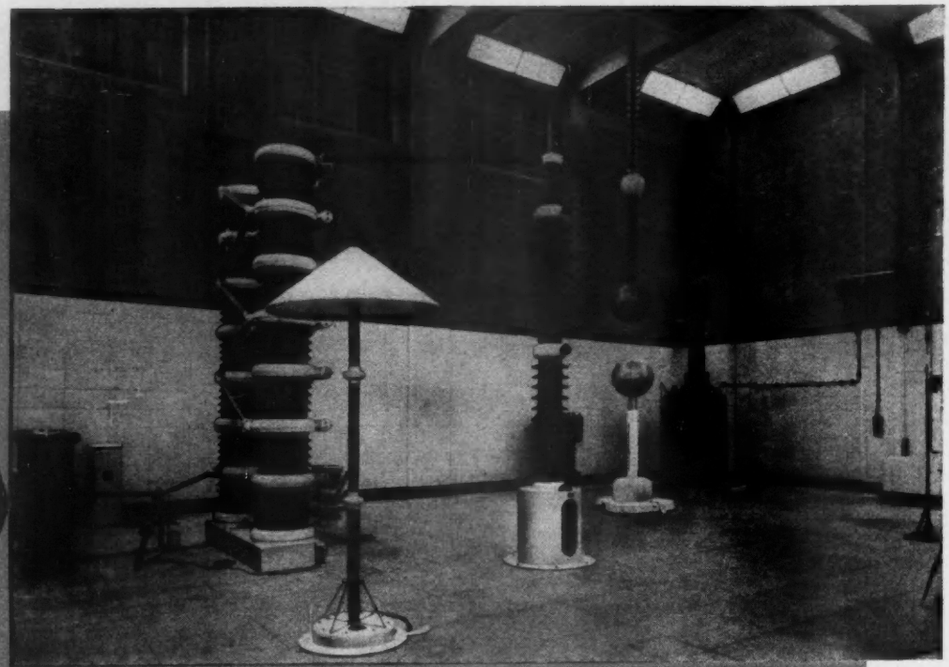

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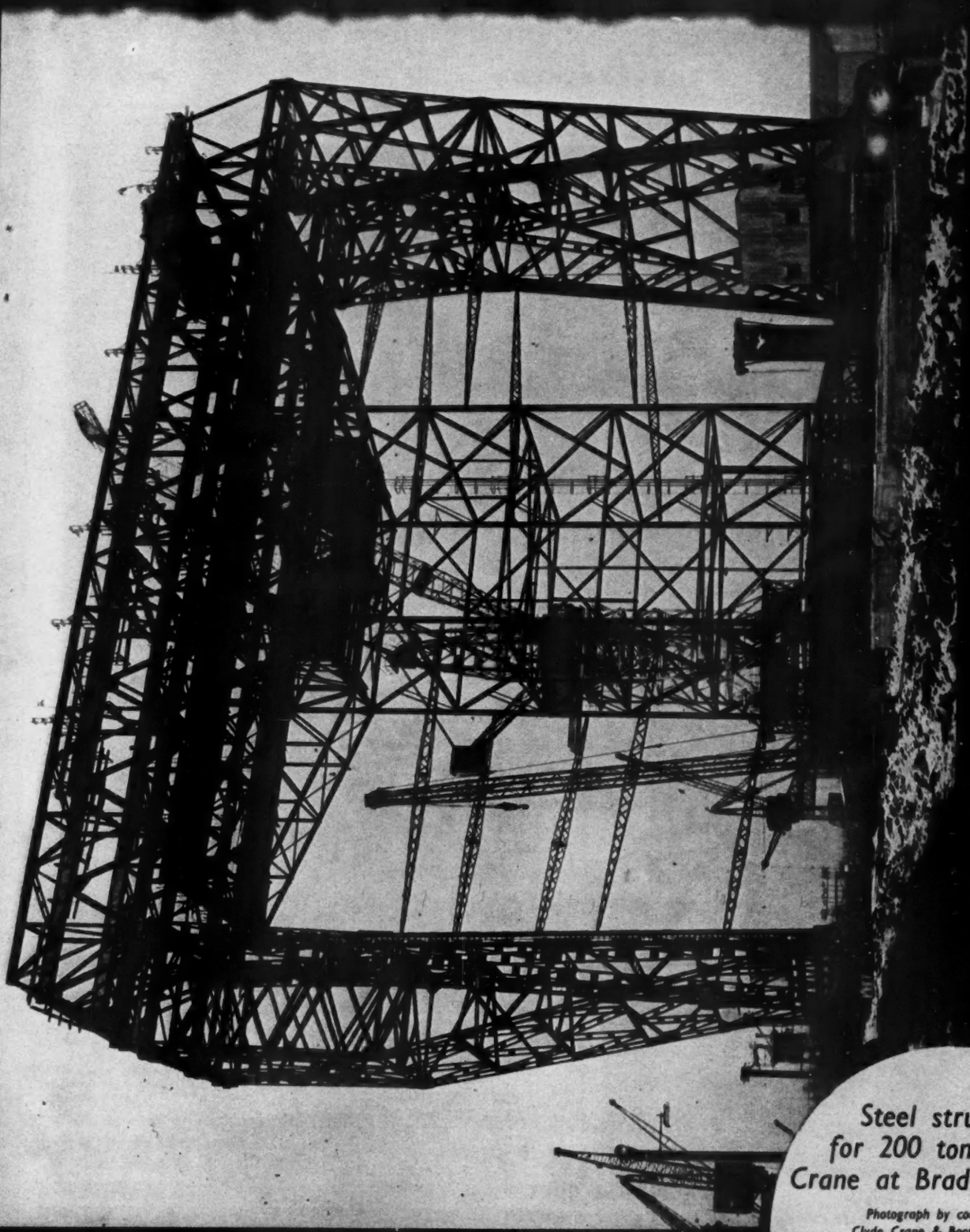

Steel structure
for 200 ton Goliath
Crane at Bradwell, Essex

*Photograph by courtesy of*
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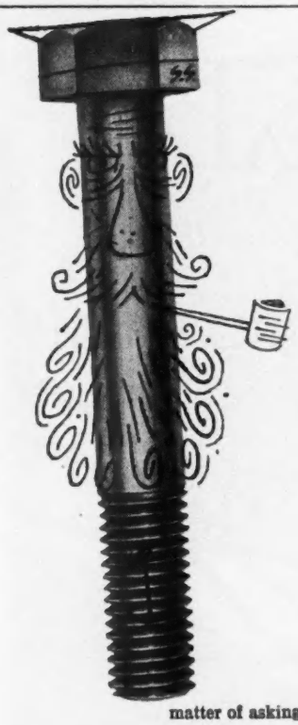

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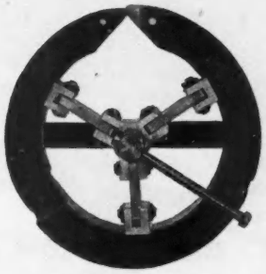

*ENSURES TRUE PIPE BEVELS*

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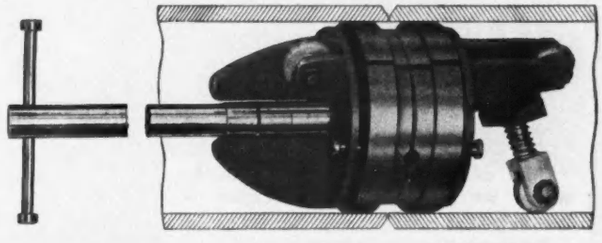
**FOR THE ACCURATE ALIGNMENT OF PIPES FROM THE BORE**



The aligner, in the contracted position, is propelled along the pipe internally in a position between the pipes to be butt welded. By operating a tommy bar on the end of extension tubes the aligner is expanded and presses out the pipe walls to their truly round form. Pressure holds the two pipes together in perfect alignment whilst the weld is laid—the aligner is then contracted and rolled along the pipe for the next weld.

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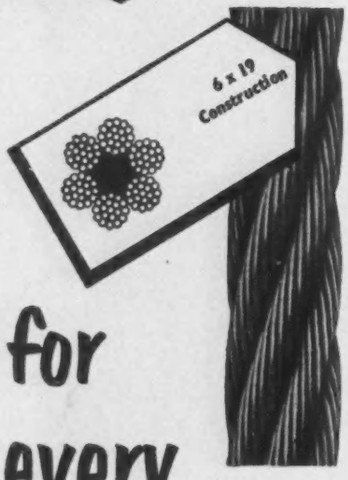


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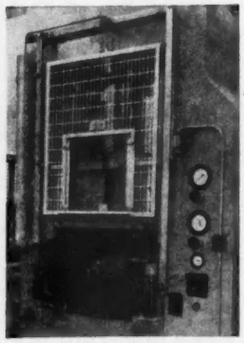

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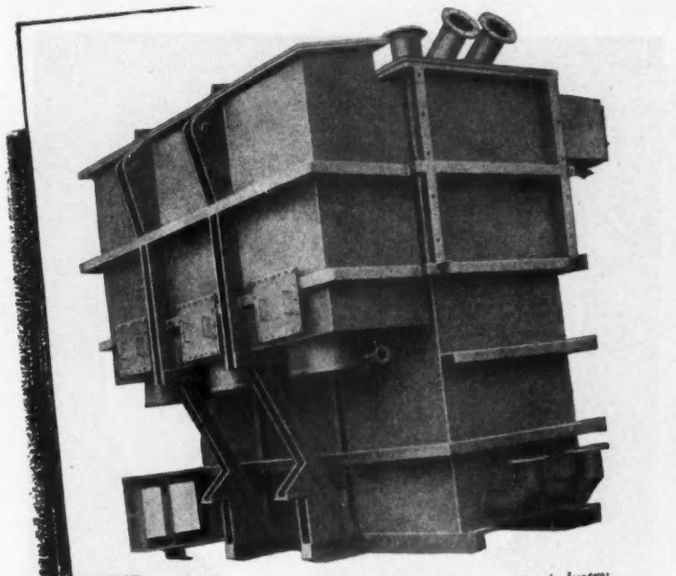

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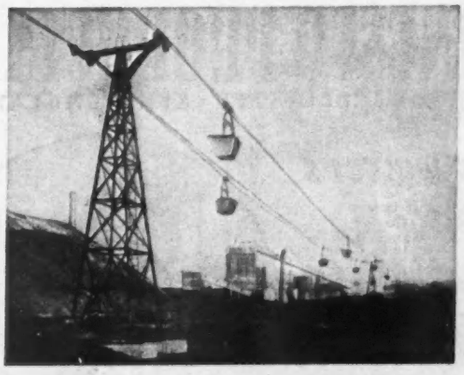


**MONOCABLE & BICABLE SYSTEMS CABLEWAYS**

*Over Sixty Years' Service to the mining Industry throughout the World*

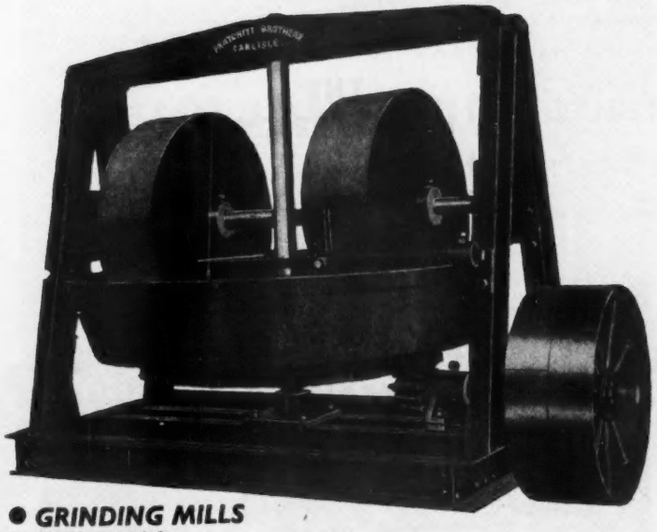
***Catalogue sent on request***

**ROPEWAYS LTD**

**62 LONDON WALL, LONDON, E.C.2.**

*Telephone: National 0124/5* *Telegrams: "Ropeways" London*

**PRATCHITT MODERN MILLS**



- ***GRINDING MILLS***
- ***PAN MILLS***
- ***EDGE RUNNER MILLS***

for grinding and mixing Mortar Sand, Ores, Minerals, etc.

**Enquiries also invited for:**

Elevators and Storage Hoppers, Impregnating Plants, Calciners, Rotary Dryers, Mixers and Blenders, Gypsum Plant, Castings up to 5 tons in weight, General Engineering Plant. Equipment manufactured to customers' drawings and specification.

**PRATCHITT BROTHERS LTD · CARLISLE**

*ENGINEERS AND IRONFOUNDERS*

FB. 13

**Follsain-Wycliffe**

FOUNDRIES LTD

*The*

**SPECIALIST FOUNDRY**

*for*

**BLACKHEART MALLEABLE IRON**

*and*

**HEAT & ABRASION RESISTING ALLOY CASTINGS**

*for*

Automobiles and commercial Vehicles
Gas, Electricity and Steel Undertakings
Mining and Quarrying Plant
Cement, Brick, Pipe and Tile Works
Heat Treatment Plants
*together with many others*

**CASTINGS SUPPLIED AS CAST OR FULLY MACHINED**

Manufacturers of 'PULMAC' Pulverising Mills for Fine Grinding

**FOLLSAIN-WYCLIFFE FOUNDRIES LTD**

**Lutterworth, nr. Rugby. Tel: Lutterworth 10, 60 & 152**

**Grams: Wycliffe, Lutterworth**

# AIRNESCO PRODUCTS LTD.

· STROOD · ROCHESTER · KENT · ENGLAND ·

*This winter's*
**BUNKER TRIMMING**

THE OLD WAY

THE NEW SAFETY WAY

Percussion Lancing...

✱ Keeps men out of the Bunkers
✱ Clears stoppages faster
✱ Costs Less

*May we demonstrate at Your works?* TELEPHONE STROOD 78310

# Budenberg

TRADE MARK

We now have good stocks of
**PRESSURE GAUGES**
2½", 3", 4" and 6" dials
in all standard ranges.

**BUDENBERG GAUGE CO. LTD.,**
BROADHEATH Nr. MANCHESTER
London REGENCY HOUSE, 1/4 WARWICK STREET, LONDON W.1
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Glasgow 62 ROBERTSON STREET, GLASGOW C.2

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# NARITE

*The* DIE METAL SUPERB

THE HEMISPERICAL SHAPES THAT FORM THE BODY OF THE **HOOVER** CONSTELLATION CLEANER ARE DEEP DRAWN BY NARITE DIES

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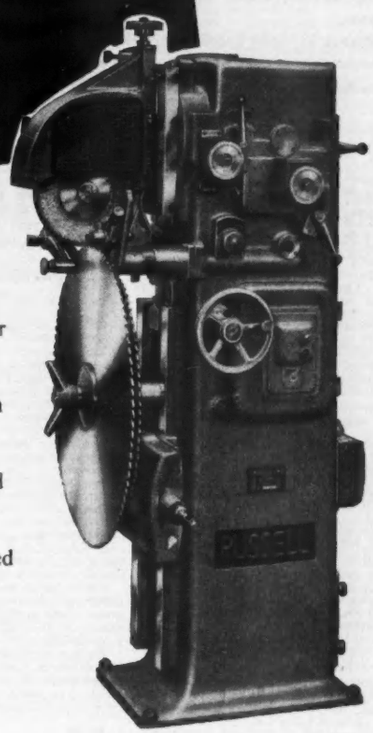
**ST ANDREW'S ROAD**
**HUDDERSFIELD**

TELEPHONE: HUDDERSFIELD 6263/4

C.W. 4028

# RUSSELL

## 11/40 AUTOMATIC SAW SHARPENING MACHINE



- Tooth form (variable) automatically generated
- Height difference of leader and follower teeth is automatic
- Automatic Pitch Doubler for tooth bevelling
- Rigid construction ensures accurate and rapid sharpening
- Operating mechanism totally enclosed and running in oil
- Built-in motor-driven dust exhauster
- Simple to operate

Damaged or broken teeth are caused by neglect. Economical saw blade life can only be obtained by keeping blades in good condition. This means frequent and regularly planned grinding. A machine specially designed to sharpen the tooth form of the modern circular cold saw blade provides the only efficient method of carrying out this operation.

**S. RUSSELL & SONS LIMITED, LEICESTER, ENGLAND**

*Backed by over forty years' specialised experience.*

SR.551

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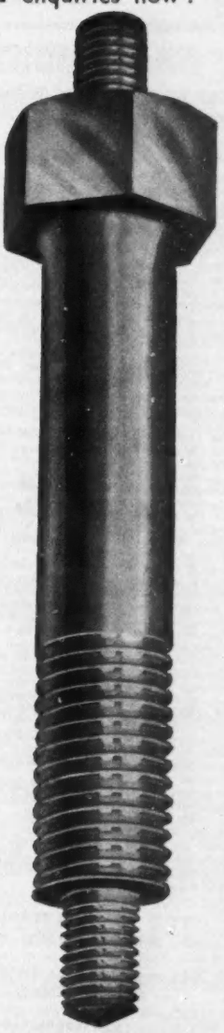
**REPETITION SPECIALISTS**

All types of automatic and capstan bar work. Send us your drawings and enquiries now!



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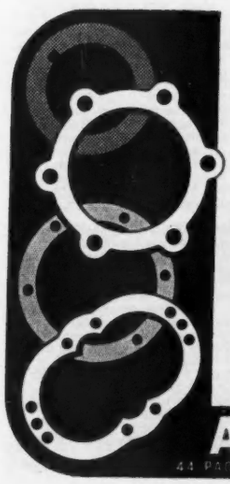
COLLARS · WHEEL KEYS
BOLTS & NUTS · STUDS
SCREWED ROD · TAPER
AND COTTER PINS, etc.

**H. FORDSMITH**
LIMITED
HADFIELD ST. WORKS
CORNBROOK · MANCHESTER, 16
Telephone: Trafford Park 1615-6



*FOR MILLING CUTTERS · SLITTING KNIVES AND SAWS · BALL AND ROLLER BEARINGS · GEARS AND MANY OTHER PURPOSES—*

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PRECISION PLASTIC SHIMS
From ·0005", ·001", ·0015" up to ·040"

"THE COLOUR TELLS THE THICKNESS"

EASY TO IDENTIFY · EASY TO USE
*Write for Samples and Literature or Mail Blueprint for quotation*

**AUTO AERO LTD.**
44 PACKINGTON ROAD LONDON W.5

HAMMERED OR HYDRAULIC PRESSED

**FORGINGS**

IN STEEL
BLACK OR MACHINED
TO 24 TONS

INCE FORGE CO. WIGAN
PARKS FORGE LTD
PROPRIETORS

# CLASSIFIED ADVERTISEMENTS

**AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS**

**Lineage Rate.** 4/- per line of approximately 6 words. Minimum 16/-.

**Inch Rate.** 48/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

**AUCTION SALES · FOR HIRE · MACHINERY, etc., WANTED · SITUATIONS WANTED DRAWING AND DESIGN SERVICES · FOR SALE · SUB-CONTRACTING**

**Lineage Rate.** 3/6 per line of approximately 6 words. Minimum 14/-.

**Inch Rate.** 42/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £22. ½-page £41 10s. Full page £78.

**Series Discounts.** For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

**Run-On and Semi-Displayed Styles.** Both these styles are available for single column width advertisements of any depth up to 12 inches.

**Displayed and Illustrated Styles.** The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

**Use of Box Number.** 2/- which includes forwarding of replies.

**Copy Dates.** "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to:*—Classified Advertisement Dept., "The Engineer" 28 Essex Street, Strand, London, W.C.2.**

***Urgent advertisements may be telephoned to CENtral 6565.***

## PUBLIC APPOINTMENTS

### THE NEW SOUTH WALES UNIVERSITY OF TECHNOLOGY

#### NEWCASTLE UNIVERSITY COLLEGE

#### VACANCIES FOR ASSOCIATE PROFESSORS IN ARTS, ENGINEERING AND SCIENCE

The New South Wales University of Technology invites applications for newly created ASSOCIATE PROFESSORSHIPS IN ARTS, ENGINEERING AND SCIENCE at Newcastle University College.

One appointment will be made in each of the Departments of Arts, Engineering and Science, with salary of £A2861 per annum.

In the Department of Arts the major courses of study are English, History, Philosophy, Psychology, Classics, Modern Languages and Geography.

In the Department of Engineering the major courses of study are Mechanical, Electrical and Civil Engineering.

In the Department of Science the courses are Chemistry, Mathematics and Physics.

Applicants should be of high academic standing in one of the fields mentioned and on appointment will operate as Head of the Department concerned.

The successful applicant will be expected to promote the development of the activities of the Department: in academic matters he will work in association with the Dean of the Faculty concerned of the University.

Newcastle University College is administered by the Warden under the Vice-Chancellor and Council of the New South Wales University of Technology.

The successful applicant will be eligible, subject to a satisfactory medical report, to contribute to the State Superannuation Fund, providing a pension of £A1400 per annum on retirement.

Associate Professors are eligible for six months' study leave on full salary after three years of service, or twelve months after six years of service.

Subject to the consent of the University, Associate Professors may engage in a limited amount of higher consultative work.

The University reserves the right to fill the position by invitation.

First-class ship fares to Sydney of appointees and their families will be paid.

Four copies of applications (including the names of three referees) and supporting documents, should be lodged with the Agent General for New South Wales, 56, Strand, London, W.C.2, and a copy forwarded in an envelope marked "University Appointment," by airmail, to the Bursar, Box 1, Post Office, Kensington, New South Wales, Australia, by the 31st July, 1958. E7707

### THE POLYTECHNIC,

**309, REGENT STREET, W.1.**

#### CIVIL AND MECHANICAL ENGINEERING DEPARTMENT

#### LECTURER

Applications are invited for the post of full-time LECTURER IN CIVIL ENGINEERING.

The salary scale commences at £1200 per annum, rising by annual increments of £30 to £1350, plus London allowance of £36 or £48 per annum. The post is subject to superannuation and some concession in this respect may be made for previous industrial employment.

Further particulars and a form of application which should be returned not later than 4th July, may be obtained from the undersigned.

J. E. RICHARDSON,
Director of Education.
E7709

### LONDON COUNTY COUNCIL

#### POPLAR TECHNICAL COLLEGE

#### TWO GRADE B ASSISTANTS

Poplar Technical College, as soon as possible. Two Grade B ASSISTANTS for work with National Certificate and/or National Diploma and/or City and Guilds Classes in Mechanical Engineering and Naval Architecture Department.

Burnham F.E. salary scale: £650 by £25 to £1025, plus London allowance; additions for training and qualifications; increments within scale for experience.

Application forms from Secretary at College, Poplar High Street, E.14, to be returned by 4th July, 1958. (1160) E7714

## PUBLIC APPOINTMENTS

### KUMASI COLLEGE OF TECHNOLOGY

(Principal: W. E. DUNCANSON, Ph.D., D.Sc., F.Inst.P., A.M.I.E.E.)

#### LECTURERS

Applications are invited for the following appointments:—

(a) SENIOR LECTURER or LECTURER IN ELECTRIC POWER MACHINES.

(b) SENIOR LECTURER and LECTURER IN ELECTRICAL ENGINEERING.

The College prepares students for the London University B.Sc. Degree in Engineering and for the examinations of the professional Engineering Institutions.

Qualifications: good Honours Degree; A.M.I.E.E., or equivalent professional qualification; industrial and teaching experience in the case of those applying for the Senior Lectureships.

Appointment may be accepted on contract for 5 years or on pension. Arrangements to continue policies initiated under F.S.S.U. scheme might be made by the College.

Contract salary scales: Senior Lecturer, £2125 by £75 to £2425 p.a.; Lecturer, £1281 5s. by £62 10s. to £2031 5s. p.a., plus gratuity payable at end of contract at the rate of £12 10s. for each month of satisfactory service. Pensionable and F.S.S.U. salary scales: Senior Lecturer, £1580 by £60 to £1940 p.a.; Lecturer, £925 by £50 to £1625 p.a. Point of entry according to experience.

Children's allowances up to a maximum of three at the rate of £50 p.a. per child up to 10 years, and £100 p.a. per child over 10 years in full-time education up to 21 years. Annual leave with free return first-class passages for member of staff and, conditional on minimum stay in West Africa, his wife and up to three children under 17 years. Bungalows with basic furniture at low rental provided. Income tax low.

Applications (6 copies), giving age, education, qualifications, experience and the names of 3 referees, should be sent to the Council for Overseas Colleges, 12, Lincoln's Inn Fields, London, W.C.2. Closing date 4th July, 1958. E7740

### NOTTINGHAM AND DISTRICT TECHNICAL COLLEGE,

**SHAKESPEARE STREET, NOTTINGHAM**

Principal: D. A. R. CLARK, M.Sc. (Tech.), M.I.Mech.E.

#### RESEARCH ASSOCIATE IN MECHANICAL ENGINEERING

Applications are invited from Engineering Graduates for appointment to the post of RESEARCH ASSOCIATE IN MECHANICAL ENGINEERING. Previous research experience is desirable, but not essential. The post offers considerable scope, and encouragement will be given to obtain higher qualifications.

Salary £650 by £50 to £750 per annum.

Further particulars and form of application may be obtained from the Principal, to whom completed forms should be returned not later than 4th July, 1958. E7723

### COUNTY BOROUGH OF WEST HAM EDUCATION COMMITTEE

#### WEST HAM COLLEGE OF TECHNOLOGY,

ROMFORD ROAD, STRATFORD, E.15

Principal: E. A. RUDGE, M.Sc., Ph.D., A.M.I.Chem.E.

#### LECTURER

Required: Full-time LECTURER IN CIVIL ENGINEERING, to teach up to University Degree and H.N.C. standard. Candidates should be Graduates with industrial and teaching experience.

Salary: Burnham (London) Scale, i.e. £1200 by £30 to £1350, plus London Allowance.

Application forms and particulars can be obtained from the Principal.

R. OPENSHAW,
Chief Education Officer.

Education Department,
95, The Grove,
Stratford, E.15. E7749

## PUBLIC APPOINTMENTS

### COLLEGE OF TECHNOLOGY, BIRMINGHAM

(DESIGNATED COLLEGE OF ADVANCED TECHNOLOGY)

#### DEPARTMENT OF MECHANICAL ENGINEERING

#### APPOINTMENTS

Applications are invited for the posts of:

SENIOR LECTURERS and LECTURERS in Mechanical Engineering, specialising in either Strength of Materials, Mechanics of Fluids, Thermodynamics, Mechanics of Machines or Machine Design.

Candidates should have an Honours Degree or equivalent, teaching, industrial and/or research experience.

An ASSISTANT GRADE "B" is also required, mainly for Engineering Drawing.

Salary scale: Senior Lecturers (men), £1350 by £50 to £1550.

Lecturers (men), £1200 by £30 to £1350.

In fixing the commencing salary, account may be taken of industrial, professional or research experience up to the maximum of the scale.

Assistants Grade "B" (men), £650 by £25 to £1025, with additional graduate and training allowances where applicable. In fixing the commencing salary, account will be taken of teaching and industrial experience.

Further particulars and forms of application from the Registrar, College of Technology, Gosta Green, Birmingham, 4, on receipt of stamped, addressed, foolscap envelope. Applications to be received within 18 days of this advertisement.

K. R. PILLING,
E7744 Clerk to the Governing Body.

### KUMASI COLLEGE OF TECHNOLOGY

(Principal: W. E. DUNCANSON, Ph.D., D.Sc., F.Inst.P., A.M.I.E.E.)

#### SENIOR LECTURERS

Applications are invited for the posts of SENIOR LECTURERS in the Department of Mechanical Engineering.

The College prepares students for the London University B.Sc. Degree in Engineering and for the examinations of the professional Engineering Institutions.

Applicants should have a Degree or equivalent qualifications with suitable teaching and professional qualifications. Duties will involve some of the following:—Teaching of Strength of Materials and Metallurgy, Theory and Design of Machines, Engineering Drawing; taking charge of applied Thermodynamics Laboratory.

Appointment may be accepted on contract for 5 years or on pension or arrangements to continue policies initiated under the F.S.S.U. scheme might be made by the College.

Contract salary scale: £2125 by £75 to £2425 p.a. plus a gratuity payable at the end of contract at the rate of £12 10s. for each month of satisfactory service. Pensionable and F.S.S.U. salary scale: £1580 by £60 to £1940 p.a. Point of entry according to experience.

Children's allowances up to a maximum of three at the rate of £50 p.a. per child up to 10 years and £100 p.a. per child over 10 years in full-time education up to 21 years. Annual leave with free return first-class passages for the member of staff and, conditional on a minimum stay in West Africa, for his wife and up to three children under 17 years. Bungalows with basic furniture at low rental are provided. Income tax low.

Applications (6 copies), giving age, qualifications, experience and the names of 3 referees, should be sent to the Council for Overseas Colleges, 12, Lincoln's Inn Fields, London, W.C.2. Closing date: 4th July, 1958. E7739

### THE UNIVERSITY OF SHEFFIELD

#### POSTGRADUATE DEPARTMENT OF APPLIED MECHANICS

#### LECTURER

Applications are invited for a post of LECTURER in the Postgraduate Department of Applied Mechanics, to begin duties on 1st January, 1959. Salary scale £900 by £50 to £1350 by £75 to £1650, with F.S.S.U. provision and family allowance. Initial salary according to qualifications and experience.—Further particulars should be obtained from the Registrar, to whom applications (4 copies) should be sent by 19th July, 1958. E7697

## PUBLIC APPOINTMENTS

### NOTTINGHAMSHIRE EDUCATION COMMITTEE

#### MANSFIELD TECHNICAL COLLEGE

Principal: R. F. BEATON, B.Sc. (Eng.), Wh.Sch.

#### APPOINTMENTS

Applications are invited for the following appointments in the Engineering Department.

(a) LECTURER IN MECHANICAL ENGINEERING.—Applicants should be capable of teaching one or more of the subjects, Strength of Materials, Theory of Structures, Theory of Machines, Thermodynamics, to the level of the Higher National Certificate. They should hold the Graduate or equivalent qualifications and have had appropriate industrial and preferably some teaching experience.

(b) ASSISTANT, Grade "A."—The teaching duties will be mainly in pre-senior and craft courses leading to City and Guilds examinations. Candidates should be suitably qualified and have had industrial and preferably some teaching experience. Salaries are in accordance with the Burnham Technical Scales.

Lecturer: £1200 by £30 to £1350 per annum.

Assistant, Grade "A": £475 by £25 to £900 per annum.

On the Grade "A" scale, additions are made for certain qualifications and study training and the position on the scale is dependent on previous industrial and teaching experience.

Forms of application may be obtained from the Divisional Education Officer, Education Office, Market Place, Mansfield, to whom they should be returned within two weeks of the appearance of this advertisement.

J. EDWARD MASON,
Director of Education.
County Hall,
Nottingham. E7719

### UNIVERSITY OF MANCHESTER

#### ELECTRICAL OR MECHANICAL ENGINEERS OR PHYSICISTS

There are vacancies in the Department of Physics of the Faculty of Science for Graduate ELECTRICAL or MECHANICAL ENGINEERS or PHYSICISTS, to form part of a research team, developing a linear accelerator for nuclear physics research. The work will involve the design of new apparatus and the supervision of the manufacture of large-scale equipment. Salary in accordance with qualifications.

Applications should be sent not later than July 14th, 1958, to Professor S. Devons, the University, Oxford Road, Manchester, 13. E7751

### THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY

#### INDUSTRIAL GROUP

#### RISLEY, WARRINGTON, LANCASHIRE

#### HEATING AND VENTILATING ENGINEER

The United Kingdom Atomic Energy Authority, Industrial Group, requires an ENGINEER at its Headquarters at Risley, Warrington, Lancashire, to lead a team engaged on the design of building services, including high and low pressure hot water and steam heating, hot water supply, ventilation and air conditioning systems. The work may include the design and layout of large kitchens and the layout of mechanical plant.

A recognised engineering apprenticeship, or comparable training, and Corporate Membership of the Institution of Civil or Mechanical Engineers, or equivalent qualifications, are essential. Experience in the design of large heating, ventilation and air conditioning systems, the control of staff engaged on this type of work, and ability to co-ordinate the design of building services with other offices engaged on building projects are required. Corporate Membership of the Institution of Heating and Ventilating Engineers will be an advantage.

Salary will be assessed within scale £1300–£1740.

Contributory pension scheme.

A house or assistance towards legal expenses on house purchase may be available.

Send postcard for application form, quoting reference 2461, to Recruitment Officer, at the above address.

Closing date: 14th July, 1958. E7729

## PUBLIC APPOINTMENTS

### CITY OF LEEDS

#### WATERWORKS DEPARTMENT

#### APPOINTMENT OF ENGINEERING STAFF

Applications are invited for the undermentioned appointments :—

(a) ENGINEERING ASSISTANT, A.P.T. Grade III—£845–£1025.
(b) ENGINEERING ASSISTANTS (2), A.P.T. Grade II—£725–£845.
(c) ENGINEERING ASSISTANT, A.P.T. Grade I—£575–£725.
(d) DRAUGHTSMAN, Higher General Division —According to age, maximum £560.

Applicants for post (a) must have had experience in the design and construction of reinforced concrete water retaining structures and experience in the design and installation of rapid gravity filtration plants and pumping plants will be an advantage.

Applicants for posts (b) and (c) must have general engineering experience, preferably with a Water Engineer, and experience in design and construction of reinforced concrete structures will be an advantage for post (b).

Applicants for post (d) must be neat draughtsmen, preferably with experience in civil engineering drawings.

Applicants for post (a) must be Corporate Members of the Institution of Civil Engineers, and for post (b) must have passed Parts I and II of the Corporate Membership examination or hold a University Degree exempting them therefrom.

The grading of the posts and conditions of service are in accordance with the National Scheme of Conditions of Service.

The appointments are subject to the provisions of the Local Government Superannuation Acts.

Selected candidates will be required to pass the Corporation's medical examination.

The persons appointed will be required to devote the whole of their time to the business of the Corporation, and will not be allowed to engage either directly or indirectly in private work of any kind.

The appointments will be subject to one month's notice on either side.

Applications, on forms to be obtained from the undersigned, should be delivered not later than 12 noon on Wednesday, the 9th July, 1958, endorsed with the description of the post applied for.

Canvassing in any form, either directly or indirectly, will be a disqualification.

KENNETH L. FORSTER,
General Manager and Engineer.

Waterworks Department,
Civic Hall,
Leeds, 1.
13th June, 1958. E7745

### CITY OF PLYMOUTH

#### APPOINTMENT OF SPECIAL STAFF FOR BRIDGE DESIGN AND CONSTRUCTION

#### DRAUGHTSMEN

Applications are invited for the following appointments :—

DRAUGHTSMEN, at a salary up to £660 per annum, according to qualifications and experience, to be employed on the preparation of drawings for the new Laira Bridge. The applicants should be quick, accurate draughtsmen, preferably with previous experience in the detailing of reinforced concrete.

It is anticipated that subject to satisfactory service the appointments will last for a period of three years.

Age limit 40 or 45 if already serving with a Local Authority. The appointments are subject to medical examination and the successful applicants will be required to contribute to the superannuation fund.

Housing accommodation will, under certain circumstances, be made available and part of removal expenses will be refunded.

Applications, on forms obtainable from me, are returnable within 14 days of the appearance of this advertisement.

J. PATON WATSON, C.B.E., M.I.C.E.,
City Engineer and Surveyor.

The Guildhall,
Plymouth. E7696

### CITY OF CARDIFF

#### CORPORATION WATERWORKS

#### APPOINTMENT OF ENGINEERING ASSISTANT

Applications are invited for the permanent appointment of ENGINEERING ASSISTANT (Special Grade, £750–£1030 p.a.) on the staff of the Water Engineer and Manager. The commencing salary will depend upon experience and qualifications.

Applicants must have passed Sections "A" and "B" of the Associate Membership Examination of the Institution of Civil Engineers, or possess an Engineering Degree giving exemption therefrom.

General conditions and further details of this appointment can be obtained from the Water Engineer and Manager, City Hall, Cardiff, and applications, stating age, previous experience and qualifications, together with the names of two referees, should reach the undersigned, in envelopes appropriately endorsed, not later than Thursday, the 3rd July, 1958.

S. TAPPER-JONES,
Town Clerk.

City Hall,
Cardiff.
10th June, 1958. E7695

### COUNTY BOROUGH OF EAST HAM

#### ASSISTANT ENGINEER (MECHANICAL) GRADE II

ASSISTANT ENGINEER (MECHANICAL) GRADE II, £725–£845.

London weighting is paid in addition. Salary in excess of the minimum may be paid according to qualifications and experience.

A subsistence allowance may be granted over a reasonable period to the person appointed if unable to obtain suitable housing accommodation, necessitating the maintenance of two homes.

Further details and application forms, returnable by 4th July, 1958, from the Town Clerk, Town Hall, E.6. E7699

## PUBLIC APPOINTMENTS

### COMMONWEALTH OF AUSTRALIA

#### COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

#### COAL RESEARCH SECTION

#### APPOINTMENT NO. 480/259 OF FUEL TECHNOLOGIST OR PHYSICIST

A senior position is vacant with the Organisation's Coal Research Section located at North Ryde, New South Wales, for a FUEL TECHNOLOGIST OR PHYSICIST, who, under the general direction of the Officer-in-Charge, will be responsible for research work on the mechanical properties of coal and coke, their strength and the breakage processes involved in size degradation, and the industrial significance thereof.

This work is part of the Section's programme of assessment of the properties of Australian coals and cokes and of investigations into their efficient utilisation, which is being undertaken on a national basis and is of the greatest importance to the fuel industry of Australia. The Section's laboratories are particularly well equipped with new scientific equipment for this work.

In deciding the exact fields of study, consideration will be given to the personal inclinations of the successful applicant. Particular emphasis will, however, be laid on a fundamental approach to the problems involved, as distinct from purely technological implications.

Applicants should possess a University Honours Degree in Fuel Technology or Science, with considerable post-graduate research experience in the field indicated.

Dependent upon qualifications and experience, commencing salary will be determined within the salary ranges of Senior Research Officer, £A2061–£A2336 p.a., or Principal Research Officer, £A2556–£A2996 p.a. Salary for a female appointee would be £A170 less than the corresponding male rates.

The appointment will be conditional upon a satisfactory medical examination and appointment carries with it Commonwealth Superannuation Fund or Commonwealth Provident Account privileges.

An appointee migrating from overseas will be eligible for first-class sea or air transport to Australia for himself, his wife and family. An appropriate contribution will also be made towards the fares of an Australian appointee, his wife and family, temporarily abroad for study or similar purposes.

Applications, quoting Appointment No. 480/259, and stating full name, place, date and year of birth, nationality, marital state, present employment, details of qualifications and experience, and of war service, if any, together with the names of not more than four persons acquainted with the applicant's academic and professional standing, should reach the undersigned, from whom further particulars may be obtained, by the 19th July, 1958

A. SHAVITSKY,
Chief Scientific Liaison Officer.

Australian Scientific Liaison Office,
Africa House, Kingsway, W.C.2. E7721

## PUBLIC APPOINTMENTS

### COMMONWEALTH OF AUSTRALIA

#### COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

#### COAL RESEARCH SECTION

#### APPOINTMENT NO. 480/260 OF FUEL TECHNOLOGIST OR COMBUSTION ENGINEER

Applications are invited for appointment to a position of FUEL TECHNOLOGIST or COMBUSTION ENGINEER with the Organisation's Coal Research Section located at North Ryde, New South Wales.

This is a senior position and the appointee, under the general direction of the Officer-in-Charge, will act as leader of a team engaged in research into the combustion characteristics of Australian coals and the cokes made therefrom.

This work is part of the Section's programme of assessment of the properties of Australian coals and cokes, and of investigations into their efficient utilisation, which is being undertaken on a national basis and is of the greatest importance to the fuel industry of Australia. The Section's laboratories are particularly well equipped with new scientific equipment for this work.

In deciding the exact fields of study, consideration will be given to the personal inclinations of the successful applicant. Particular emphasis will, however, be laid on a fundamental approach to the problems involved, as distinct from purely technological implications. At present the programme includes research into ash deposition and clinkering phenomena and into the burning of coal and coke in suspension and in model fuel beds.

Applicants should possess a University Honours Degree in Fuel Technology or Science, with considerable post-graduate research experience in the field indicated.

Dependent upon qualifications and experience, commencing salary will be determined within the salary ranges of Senior Research Officer, £A2061–£2336 p.a., or Principal Research Officer, £A2556–£A2996 p.a. Salary for a female appointee would be £A170 less than the corresponding male rates.

The appointment will be conditional upon a satisfactory medical examination and appointment carries with it Commonwealth Superannuation Fund or Commonwealth Provident Account privileges.

An appointee migrating from overseas will be eligible for first-class sea or air transport to Australia for himself, his wife and family. An appropriate contribution will also be made towards the fares of an Australian appointee, his wife and family, temporarily abroad for study or similar purposes.

Applications, quoting Appointment No. 480/260, and stating full name, place, date and year of birth, nationality, marital state, present employment, details of qualifications and experience, and of war service, if any, together with the names of not more than four persons acquainted with the applicant's academic and professional standing, should reach the undersigned, from whom further particulars may be obtained, by 19th July, 1958.

A. SHAVITSKY,
Chief Scientific Liaison Officer.

Australian Scientific Liaison Office,
Africa House, Kingsway, W.C.2. E7720

## PUBLIC APPOINTMENTS

### DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

#### HYDRAULICS RESEARCH STATION, WALLINGFORD, BERKS

#### SENIOR SCIENTIFIC OFFICER

D.S.I.R. Hydraulics Research Station, Wallingford, Berks, requires SENIOR SCIENTIFIC OFFICER, to investigate the mechanics of water waves, beach processes and harbour problems. Qualifications : First or Second Class Honours Degree, preferably in Civil or Mechanical Engineering, with good knowledge of Hydraulics, and at least 3 years' post-graduate experience, preferably of hydraulics research, but scientific experience in wave motion other than of water, will be relevant. Salary range £1130–£1330 (men). Prospects of promotion, and for candidates under 31 also of establishment. Good housing prospects for married staff.—Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting E 225/8A. Closing date 19 July, 1958. E7741

## ENGINEERING WORKSHOPS MANAGER

A Manager is required for the National Coal Board's Area Central Workshops in Warwickshire.

The workshops will be brought into commission early in 1959. They will be mainly concerned with the reconditioning of mining machinery and will employ 100/150 men.

Proved general engineering background and evidence of the successful application of modern production, planning and industrial managerial methods are required.

Salary within the rate £1050–£1600.

Applications, giving full details, to Area Staff Manager, National Coal Board, Lindley Lodge, Higham-on-the-Hill, Nuneaton, Warwickshire, by June 30.

E7722

## STRUCTURAL ENGINEERING DRAUGHTSMEN

required by

## MINISTRY OF WORKS

for employment in London, Scotland and Provinces on design and detailing of reinforced concrete or structural steelwork.

SALARY RANGE £550 (age 21) to £870 p.a., London (slightly less elsewhere). 5-DAY WEEK. 3½ WEEKS' ANNUAL LEAVE INITIALLY.

STARTING PAY ACCORDING TO AGE, QUALIFICATIONS AND EXPERIENCE.

GOOD PROSPECTS OF PROMOTION WITH SALARIES OF £1015 p.a. AND ABOVE.

OPPORTUNITIES FOR PERMANENT POSTS LEADING TO PENSIONS (NON-CONTRIBUTORY).

Possession of O.N.C. or equivalent an advantage.
Interviews at Regional Offices where possible.

APPLICATIONS.—State age, training and experience to Chief Structural Engineer, Ministry of Works, Room 404, Abell House, John Islip Street, S.W.1.

E7717

## ATOMIC ENERGY ESTABLISHMENT, Winfrith, Dorset.

*requires*

## ENGINEERS

*for the Design Section of the Reactor Services Group.*

**ENGINEER I** (Ref. No. W.17/25), to lead a team of Mechanical Engineers engaged in reactor design, preparation of basic specifications and layouts.
Wide experience in engineering design, heat transfer and shielding will be an advantage.

**ENGINEERS II/III** (Ref. No. W.18/25), to undertake the design and commissioning of control and instrumentation systems for research reactors and their associated experimental equipment.
Previous experience in the fields of industrial process control, electronics and telephone type circuit technique, or light electro-mechanical equipment design will be an advantage.

**ENGINEERS II/III** (Ref. No. W.19/25), to undertake the design of components for reactor and reactor buildings, together with the preparation of specifications.
Previous experience in a design office will be an advantage.

In all cases applicants should be Corporate Members of a Senior Engineering Institution or have exempting qualifications. They must also have served a recognised engineering apprenticeship or have had equivalent recognised training.

| SALARY: | | |
|---|---|---|
| | Engineer I | £1790–£2060 p.a. |
| | Engineer II | £1300–£1740 p.a. |
| | Engineer III | £815 (at age of 25)–£1270 p.a. (highest age pay £1110) |

*Send POST CARD for application form, quoting appropriate reference, to Group Recruitment Officer, A.E.R.E., Harwell, Didcot, Berks.*

E7474

## TENDERS

### THE COMMISSIONERS FOR THE PORT OF CALCUTTA

#### NEW DOUBLE LADDER BUCKET DREDGER

TENDERS are invited from experienced Bucket Dredger Builders for the CONSTRUCTION and SUPPLY of a

TWIN SCREW STERN WELL DOUBLE LADDER BUCKET DREDGER.

of the following dimensions :
Length B.P. not exceeding 175ft. 6in. (53·50 metres).
Breadth moulded, not exceeding 44ft. (13·40 metres).
Depth 17ft. 9in. (5·41 metres).
Draught approximately 13ft. 6in. (3·81 metres).
Speed at maximum draught 9·5 knots at 4/5ths power.

Drawings, specifications and conditions of contract may be obtained by Shipbuilders from the Commissioners' Consulting Engineers, Messrs. Rendel, Palmer and Tritton, 125, Victoria Street, Westminster, London, S.W.1, on payment of a deposit of Rs.25,000 or £1875 Sterling, returnable on adjudication. Applications from Agents or other intermediaries will not be considered.

Tenderers are required, on submitting their Tenders, to enclose with their specifications and drawings, proof of their recent experience in building dredgers of this particular type.

Tenders, in sealed envelopes, endorsed on the outside "TENDER FOR NEW DOUBLE LADDER BUCKET DEREDGER," are to be submitted, in triplicate, of which one copy is to be addressed to :—
The Deputy Conservator,
The Commissioners for the Port of Calcutta,
15, Strand Road,
CALCUTTA,
India.
and two copies addressed to :—
Messrs. Rendel, Palmer and Tritton,
Consulting Engineers,
125 Victoria Street,
Westminster,
LONDON,
S.W.1.

The Tenders must reach the Deputy Conservator not later than 1700 hours I.S.T. on the 22nd September, 1958, at Calcutta, and the Consulting Engineers not later than 1130 hours G.M.T. on 22nd September, 1958.

Quotations from the Tenderers must be firm and remain open for a period of fourteen weeks from the closing date.

The Commissioners do not bind themselves to accept the lowest of any Tender and reserve the right to reject a Tender without assigning any reasons.

(Sgd.) Deputy Conservator,
CALCUTTA PORT COMMISSIONERS.

E7439

Classified Advts. continued on page 108

# CLASSIFIED ADVERTISEMENTS

**AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS**

**Lineage Rate.** 4/- per line of approximately 6 words. Minimum 16/-.
**Inch Rate.** 48/- per single column inch and *pro rata*. 12 lines to 1 inch.
There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

**AUCTION SALES · FOR HIRE · MACHINERY, etc., WANTED · SITUATIONS WANTED DRAWING AND DESIGN SERVICES · FOR SALE · SUB-CONTRACTING**

**Lineage Rate.** 3/6 per line of approximately 6 words. Minimum 14/-.
**Inch Rate.** 42/- per single column inch and *pro rata*. 12 lines to 1 inch.
There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £22. ½-page £41 10s. Full page £78.

**Series Discounts.** For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

**Run-On and Semi-Displayed Styles.** Both these styles are available for single column width advertisements of any depth up to 12 inches.
**Displayed and Illustrated Styles.** The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.
**Use of Box Number.** 2/- which includes forwarding of replies.
**Copy Dates.** "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to:*—Classified Advertisement Dept., "The Engineer" 28 Essex Street, Strand, London, W.C.2.**

***Urgent advertisements may be telephoned to CENtral 6565.***

## PUBLIC APPOINTMENTS

### THE NEW SOUTH WALES UNIVERSITY OF TECHNOLOGY

#### NEWCASTLE UNIVERSITY COLLEGE

#### VACANCIES FOR ASSOCIATE PROFESSORS IN ARTS, ENGINEERING AND SCIENCE

The New South Wales University of Technology invites applications for newly created ASSOCIATE PROFESSORSHIPS IN ARTS, ENGINEERING AND SCIENCE at Newcastle University College.

One appointment will be made in each of the Departments of Arts, Engineering and Science, with salary of £A2861 per annum.

In the Department of Arts the major courses of study are English, History, Philosophy, Psychology, Classics, Modern Languages and Geography.

In the Department of Engineering the major courses of study are Mechanical, Electrical and Civil Engineering.

In the Department of Science the courses are Chemistry, Mathematics and Physics.

Applicants should be of high academic standing in one of the fields mentioned and on appointment will operate as Head of the Department concerned.

The successful applicant will be expected to promote the development of the activities of the Department : in academic matters he will work in association with the Dean of the Faculty concerned of the University.

Newcastle University College is administered by the Warden under the Vice-Chancellor and Council of the New South Wales University of Technology.

The successful applicant will be eligible, subject to a satisfactory medical report, to contribute to the State Superannuation Fund, providing a pension of £A1400 per annum on retirement.

Associate Professors are eligible for six months' study leave on full salary after three years of service, or twelve months after six years of service.

Subject to the consent of the University, Associate Professors may engage in a limited amount of higher consultative work.

The University reserves the right to fill the position by invitation.

First-class ship fares to Sydney of appointees and their families will be paid.

Four copies of applications (including the names of three referees) and supporting documents, should be lodged with the Agent General for New South Wales, 56, Strand, London, W.C.2, and a copy forwarded in an envelope marked "University Appointment," by airmail, to the Bursar, Box 1, Post Office, Kensington, New South Wales, Australia, by the 31st July, 1958. E7707

### THE POLYTECHNIC,

**309, REGENT STREET, W.1.**

#### CIVIL AND MECHANICAL ENGINEERING DEPARTMENT

#### LECTURER

Applications are invited for the post of full-time LECTURER IN CIVIL ENGINEERING.

The salary scale commences at £1200 per annum, rising by annual increments of £30 to £1350, plus London allowance of £36 or £48 per annum. The post is subject to superannuation and some concession in this respect may be made for previous industrial employment.

Further particulars and a form of application which should be returned not later than 4th July, may be obtained from the undersigned.

J. E. RICHARDSON,
Director of Education.

E7709

### LONDON COUNTY COUNCIL

#### POPLAR TECHNICAL COLLEGE

#### TWO GRADE B ASSISTANTS

Poplar Technical College, as soon as possible, Two Grade B ASSISTANTS for work with National Certificate and/or National Diploma and/or City and Guilds Classes in Mechanical Engineering and Naval Architecture Department.

Burnham F.E. salary scale : £650 by £25 to £1025, plus London allowance ; additions for training and qualifications ; increments within scale for experience.

Application forms from Secretary at College, Poplar High Street, E.14, to be returned by 4th July, 1958. (1160) E7714

## PUBLIC APPOINTMENTS

### KUMASI COLLEGE OF TECHNOLOGY

(Principal : W. E. DUNCANSON, Ph.D., D.Sc., F.Inst.P., A.M.I.E.E.)

#### LECTURERS

Applications are invited for the following appointments :—

(a) SENIOR LECTURER or LECTURER IN ELECTRIC POWER MACHINES.
(b) SENIOR LECTURER and LECTURER IN ELECTRICAL ENGINEERING.

The College prepares students for the London University B.Sc. Degree in Engineering and for the examinations of the professional Engineering Institutions.

Qualifications : good Honours Degree ; A.M.I.E.E., or equivalent professional qualification ; industrial and teaching experience in the case of those applying for the Senior Lectureships.

Appointment may be accepted on contract for 5 years or on pension. Arrangements to continue policies initiated under F.S.S.U. scheme might be made by the College.

Contract salary scales : Senior Lecturer, £2125 by £75 to £2425 p.a.; Lecturer, £1281 5s. by £62 10s. to £2031 5s. p.a., plus gratuity payable at end of contract at the rate of £12 10s. for each month of satisfactory service. Pensionable and F.S.S.U. salary scales : Senior Lecturer, £1580 by £60 to £1940 p.a.; Lecturer, £925 by £50 to £1625 p.a. Point of entry according to experience.

Children's allowances up to a maximum of three at the rate of £50 p.a. per child up to 10 years, and £100 p.a. per child over 10 years in full-time education up to 21 years. Annual leave with free return first-class passages for member of staff and, conditional on minimum stay in West Africa, his wife and up to three children under 17 years. Bungalows with basic furniture at low rental provided. Income tax low.

Applications (6 copies), giving age, education, qualifications, experience and the names of 3 referees, should be sent to the Council for Overseas Colleges, 12, Lincoln's Inn Fields, London, W.C.2. Closing date 4th July, 1958. E7740

### NOTTINGHAM AND DISTRICT TECHNICAL COLLEGE,

**SHAKESPEARE STREET, NOTTINGHAM**

Principal : D. A. R. CLARK, M.Sc. (Tech.), M.I.Mech.E.

#### RESEARCH ASSOCIATE IN MECHANICAL ENGINEERING

Applications are invited from Engineering Graduates for appointment to the post of RESEARCH ASSOCIATE IN MECHANICAL ENGINEERING. Previous research experience is desirable, but not essential. The post offers considerable scope, and encouragement will be given to obtain higher qualifications.

Salary £650 by £50 to £750 per annum.

Further particulars and form of application may be obtained from the Principal, to whom completed forms should be returned not later than 4th July, 1958. E7723

### COUNTY BOROUGH OF WEST HAM EDUCATION COMMITTEE

#### WEST HAM COLLEGE OF TECHNOLOGY, ROMFORD ROAD, STRATFORD, E.15

Principal : E. A. RUDGE, M.Sc., Ph.D., A.M.I.Chem.E.

#### LECTURER

Required : Full-time LECTURER IN CIVIL ENGINEERING, to teach up to University Degree and H.N.C. standard. Candidates should be Graduates with industrial and teaching experience.

Salary : Burnham (London) Scale, i.e. £1200 by £30 to £1350, plus London Allowance.

Application forms and particulars can be obtained from the Principal.

R. OPENSHAW,
Chief Education Officer.

Education Department,
95, The Grove,
Stratford, E.15. E7749

## PUBLIC APPOINTMENTS

### COLLEGE OF TECHNOLOGY, BIRMINGHAM

(DESIGNATED COLLEGE OF ADVANCED TECHNOLOGY)

#### DEPARTMENT OF MECHANICAL ENGINEERING

#### APPOINTMENTS

Applications are invited for the posts of :

SENIOR LECTURERS and LECTURERS in Mechanical Engineering, specialising in either Strength of Materials, Mechanics of Fluids, Thermodynamics, Mechanics of Machines or Machine Design.

Candidates should have an Honours Degree or equivalent, teaching, industrial and/or research experience.

An ASSISTANT GRADE "B" is also required, mainly for Engineering Drawing.

Salary scale : Senior Lecturers (men), £1350 by £50 to £1550.

Lecturers (men), £1200 by £30 to £1350.

In fixing the commencing salary, account may be taken of industrial, professional or research experience up to the maximum of the scale.

Assistants Grade "B" (men), £650 by £25 to £1025, with additional graduate and training allowances where applicable. In fixing the commencing salary, account will be taken of teaching and industrial experience.

Further particulars and forms of application from the Registrar, College of Technology, Gosta Green, Birmingham, 4, on receipt of stamped, addressed, foolscap envelope. Applications to be received within 18 days of this advertisement.

K. R. PILLING,
E7744 Clerk to the Governing Body.

### KUMASI COLLEGE OF TECHNOLOGY

(Principal : W. E. DUNCANSON, Ph.D., D.Sc., F.Inst.P., A.M.I.E.E.)

#### SENIOR LECTURERS

Applications are invited for the posts of SENIOR LECTURERS in the Department of Mechanical Engineering.

The College prepares students for the London University B.Sc. Degree in Engineering and for the examinations of the professional Engineering Institutions.

Applicants should have a Degree or equivalent qualifications with suitable teaching and professional qualifications. Duties will involve some of the following :—Teaching of Strength of Materials and Metallurgy, Theory and Design of Machines, Engineering Drawing ; taking charge of applied Thermodynamics Laboratory.

Appointment may be accepted on contract for 5 years or on pension or arrangements to continue policies initiated under the F.S.S.U. scheme might be made by the College.

Contract salary scale : £2125 by £75 to £2425 p.a. plus a gratuity payable at the end of contract at the rate of £12 10s. for each month of satisfactory service. Pensionable and F.S.S.U. salary scale : £1580 by £60 to £1940 p.a. Point of entry according to experience.

Children's allowances up to a maximum of three at the rate of £50 p.a. per child up to 10 years and £100 p.a. per child over 10 years in full-time education up to 21 years. Annual leave with free return first-class passages for the member of staff and, conditional on a minimum stay in West Africa, for his wife and up to three children under 17 years. Bungalows with basic furniture at low rental are provided. Income tax low.

Applications (6 copies), giving age, qualifications, experience and the names of 3 referees, should be sent to the Council for Overseas Colleges, 12, Lincoln's Inn Fields, London, W.C.2. Closing date : 4th July, 1958. E7739

### THE UNIVERSITY OF SHEFFIELD

#### POSTGRADUATE DEPARTMENT OF APPLIED MECHANICS

#### LECTURER

Applications are invited for a post of LECTURER in the Postgraduate Department of Applied Mechanics, to begin duties on 1st January, 1959. Salary scale £900 by £50 to £1350 by £75 to £1650, with F.S.S.U. provision and family allowance. Initial salary according to qualifications and experience.—Further particulars should be obtained from the Registrar, to whom applications (4 copies) should be sent by 19th July, 1958. E7697

## PUBLIC APPOINTMENTS

### NOTTINGHAMSHIRE EDUCATION COMMITTEE

#### MANSFIELD TECHNICAL COLLEGE

Principal : R. F. BEATON, B.Sc. (Eng.), Wh.Sch.

#### APPOINTMENTS

Applications are invited for the following appointments in the Engineering Department.

(a) LECTURER IN MECHANICAL ENGINEERING.—Applicants should be capable of teaching one or more of the subjects, Strength of Materials, Theory of Structures, Theory of Machines, Thermodynamics, to the level of the Higher National Certificate. They should hold the Graduate or equivalent qualifications and have had appropriate industrial and preferably some teaching experience.

(b) ASSISTANT, Grade "A."—The teaching duties will be mainly in pre-senior and craft courses leading to City and Guilds examinations. Candidates should be suitably qualified and have had industrial and preferably some teaching experience. Salaries are in accordance with the Burnham Technical Scales.

Lecturer : £1200 by £30 to £1350 per annum.
Assistant, Grade "A" : £475 by £25 to £900 per annum.

On the Grade "A" scale, additions are made for certain qualifications and study training and the position on the scale is dependent on previous industrial and teaching experience.

Forms of application may be obtained from the Divisional Education Officer, Education Office, Market Place, Mansfield, to whom they should be returned within two weeks of the appearance of this advertisement.

J. EDWARD MASON,
Director of Education.

County Hall,
Nottingham. E7719

### UNIVERSITY OF MANCHESTER

#### ELECTRICAL OR MECHANICAL ENGINEERS OR PHYSICISTS

There are vacancies in the Department of Physics of the Faculty of Science for Graduate ELECTRICAL or MECHANICAL ENGINEERS or PHYSICISTS, to form part of a research team, developing a linear accelerator for nuclear physics research. The work will involve the design of new apparatus and the supervision of the manufacture of large-scale equipment. Salary in accordance with qualifications.

Applications should be sent not later than July 14th, 1958, to Professor S. Devons, the University, Oxford Road, Manchester, 13. E7751

### THE UNITED KINGDOM ATOMIC ENERGY AUTHORITY

#### INDUSTRIAL GROUP

#### RISLEY, WARRINGTON, LANCASHIRE

#### HEATING AND VENTILATING ENGINEER

The United Kingdom Atomic Energy Authority, Industrial Group, requires an ENGINEER at its Headquarters at Risley, Warrington, Lancashire, to lead a team engaged on the design of building services, including high and low pressure hot water and steam heating, hot water supply, ventilation and air conditioning systems. The work may include the design and layout of large kitchens and the layout of mechanical plant.

A recognised engineering apprenticeship, or comparable training, and Corporate Membership of the Institution of Civil or Mechanical Engineers, or equivalent qualifications, are essential. Experience in the design of large heating, ventilation and air conditioning systems, the control of staff engaged on this type of work, and ability to co-ordinate the design of building services with other offices engaged on building projects are required. Corporate Membership of the Institution of Heating and Ventilating Engineers will be an advantage.

Salary will be assessed within scale £1300–£1740.

Contributory pension scheme.

A house or assistance towards legal expenses on house purchase may be available.

Send postcard for application form, quoting reference 2461, to Recruitment Officer, at the above address.

Closing date : 14th July, 1958. E7729

## PUBLIC APPOINTMENTS

### CITY OF LEEDS

#### WATERWORKS DEPARTMENT

#### APPOINTMENT OF ENGINEERING STAFF

Applications are invited for the undermentioned appointments :—

(a) ENGINEERING ASSISTANT, A.P.T. Grade III—£845–£1025.
(b) ENGINEERING ASSISTANTS (2), A.P.T. Grade II—£725–£845.
(c) ENGINEERING ASSISTANT, A.P.T. Grade I—£575–£725.
(d) DRAUGHTSMAN, Higher General Division —According to age, maximum £560.

Applicants for post (a) must have had experience in the design and construction of reinforced concrete water retaining structures and experience in the design and installation of rapid gravity filtration plants and pumping plants will be an advantage.

Applicants for posts (b) and (c) must have general engineering experience, preferably with a Water Engineer, and experience in design and construction of reinforced concrete structures will be an advantage for post (b).

Applicants for post (d) must be neat draughtsmen, preferably with experience in civil engineering drawings.

Applicants for post (a) must be Corporate Members of the Institution of Civil Engineers, and for post (b) must have passed Parts I and II of the Corporate Membership examination or hold a University Degree exempting them therefrom.

The grading of the posts and conditions of service are in accordance with the National Scheme of Conditions of Service.

The appointments are subject to the provisions of the Local Government Superannuation Acts.

Selected candidates will be required to pass the Corporation's medical examination.

The persons appointed will be required to devote the whole of their time to the business of the Corporation, and will not be allowed to engage either directly or indirectly in private work of any kind.

The appointments will be subject to one month's notice on either side.

Applications, on forms to be obtained from the undersigned, should be delivered not later than 12 noon on Wednesday, the 9th July, 1958, endorsed with the description of the post applied for.

Canvassing in any form, either directly or indirectly, will be a disqualification.

KENNETH L. FORSTER,
General Manager and Engineer.

Waterworks Department,
Civic Hall,
Leeds, 1.
13th June, 1958. E7745

### CITY OF PLYMOUTH

#### APPOINTMENT OF SPECIAL STAFF FOR BRIDGE DESIGN AND CONSTRUCTION

#### DRAUGHTSMEN

Applications are invited for the following appointments :—

DRAUGHTSMEN, at a salary up to £660 per annum, according to qualifications and experience, to be employed on the preparation of drawings for the new Laira Bridge. The applicants should be quick, accurate draughtsmen, preferably with previous experience in the detailing of reinforced concrete.

It is anticipated that subject to satisfactory service the appointments will last for a period of three years.

Age limit 40 or 45 if already serving with a Local Authority. The appointments are subject to medical examination and the successful applicants will be required to contribute to the superannuation fund.

Housing accommodation will, under certain circumstances, be made available and part of removal expenses will be refunded.

Applications, on forms obtainable from me, are returnable within 14 days of the appearance of this advertisement.

J. PATON WATSON, C.B.E., M.I.C.E.,
City Engineer and Surveyor.

The Guildhall,
Plymouth. E7696

### CITY OF CARDIFF

#### CORPORATION WATERWORKS

#### APPOINTMENT OF ENGINEERING ASSISTANT

Applications are invited for the permanent appointment of ENGINEERING ASSISTANT (Special Grade, £750–£1030 p.a.) on the staff of the Water Engineer and Manager. The commencing salary will depend upon experience and qualifications.

Applicants must have passed Sections "A" and "B" of the Associate Membership Examination of the Institution of Civil Engineers, or possess an Engineering Degree giving exemption therefrom.

General conditions and further details of this appointment can be obtained from the Water Engineer and Manager, City Hall, Cardiff, and applications, stating age, previous experience and qualifications, together with the names of two referees, should reach the undersigned, in envelopes appropriately endorsed, not later than Thursday, the 3rd July, 1958.

S. TAPPER-JONES,
Town Clerk.

City Hall,
Cardiff,
10th June, 1958. E7695

### COUNTY BOROUGH OF EAST HAM

#### ASSISTANT ENGINEER (MECHANICAL) GRADE II

ASSISTANT ENGINEER (MECHANICAL) GRADE II, £725–£845.

London weighting is paid in addition. Salary in excess of the minimum may be paid according to qualifications and experience.

A subsistence allowance may be granted over a reasonable period to the person appointed if unable to obtain suitable housing accommodation, necessitating the maintenance of two homes.

Further details and application forms, returnable by 4th July, 1958, from the Town Clerk, Town Hall, E.6. E7699

## PUBLIC APPOINTMENTS

### COMMONWEALTH OF AUSTRALIA

#### COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

#### COAL RESEARCH SECTION

#### APPOINTMENT NO. 480/259 OF FUEL TECHNOLOGIST OR PHYSICIST

A senior position is vacant with the Organisation's Coal Research Section located at North Ryde, New South Wales, for a FUEL TECHNOLOGIST OR PHYSICIST, who, under the general direction of the Officer-in-Charge, will be responsible for research work on the mechanical properties of coal and coke, their strength and the breakage processes involved in size degradation, and the industrial significance thereof.

This work is part of the Section's programme of assessment of the properties of Australian coals and cokes and of investigations into their efficient utilisation, which is being undertaken on a national basis and is of the greatest importance to the fuel industry of Australia. The Section's laboratories are particularly well equipped with new scientific equipment for this work.

In deciding the exact fields of study, consideration will be given to the personal inclinations of the successful applicant. Particular emphasis will, however, be laid on a fundamental approach to the problems involved, as distinct from purely technological implications.

Applicants should possess a University Honours Degree in Fuel Technology or Science, with considerable post-graduate research experience in the field indicated.

Dependent upon qualifications and experience, commencing salary will be determined within the salary ranges of Senior Research Officer, £A2061–£A2336 p.a., or Principal Research Officer, £A2556–£A2996 p.a. Salary for a female appointee would be £A170 less than the corresponding male rates.

The appointment will be conditional upon a satisfactory medical examination and appointment carries with it Commonwealth Superannuation Fund or Commonwealth Provident Account privileges.

An appointee migrating from overseas will be eligible for first-class sea or air transport to Australia for himself, his wife and family. An appropriate contribution will also be made towards the fares of an Australian appointee, his wife and family, temporarily abroad for study or similar purposes.

Applications, quoting Appointment No. 480/259, and stating full name, place, date and year of birth, nationality, marital state, present employment, details of qualifications and experience, and of war service, if any, together with the names of not more than four persons acquainted with the applicant's academic and professional standing, should reach the undersigned, from whom further particulars may be obtained, by the 19th July, 1958

A. SHAVITSKY,
Chief Scientific Liaison Officer.

Australian Scientific Liaison Office,
Africa House, Kingsway, W.C.2. E7721

## PUBLIC APPOINTMENTS

### COMMONWEALTH OF AUSTRALIA

#### COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

#### COAL RESEARCH SECTION

#### APPOINTMENT NO. 480/260 OF FUEL TECHNOLOGIST OR COMBUSTION ENGINEER

Applications are invited for appointment to a position of FUEL TECHNOLOGIST or COMBUSTION ENGINEER with the Organisation's Coal Research Section located at North Ryde, New South Wales.

This is a senior position and the appointee, under the general direction of the Officer-in-Charge, will act as leader of a team engaged in research into the combustion characteristics of Australian coals and the cokes made therefrom.

This work is part of the Section's programme of assessment of the properties of Australian coals and cokes, and of investigations into their efficient utilisation, which is being undertaken on a national basis and is of the greatest importance to the fuel industry of Australia. The Section's laboratories are particularly well equipped with new scientific equipment for this work.

In deciding the exact fields of study, consideration will be given to the personal inclinations of the successful applicant. Particular emphasis will, however, be laid on a fundamental approach to the problems involved, as distinct from purely technological implications. At present the programme includes research into ash deposition and clinkering phenomena and into the burning of coal and coke in suspension and in model fuel beds.

Applicants should possess a University Honours Degree in Fuel Technology or Science, with considerable post-graduate research experience in the field indicated.

Dependent upon qualifications and experience, commencing salary will be determined within the salary ranges of Senior Research Officer, £A2061–£2336 p.a., or Principal Research Officer, £A2556–£A2996 p.a. Salary for a female appointee would be £A170 less than the corresponding male rates.

The appointment will be conditional upon a satisfactory medical examination and appointment carries with it Commonwealth Superannuation Fund or Commonwealth Provident Account privileges.

An appointee migrating from overseas will be eligible for first-class sea or air transport to Australia for himself, his wife and family. An appropriate contribution will also be made towards the fares of an Australian appointee, his wife and family, temporarily abroad for study or similar purposes.

Applications, quoting Appointment No. 480/260, and stating full name, place, date and year of birth, nationality, marital state, present employment, details of qualifications and experience, and of war service, if any, together with the names of not more than four persons acquainted with the applicant's academic and professional standing, should reach the undersigned, from whom further particulars may be obtained, by 19th July, 1958.

A. SHAVITSKY,
Chief Scientific Liaison Officer.

Australian Scientific Liaison Office,
Africa House, Kingsway, W.C.2. E7720

## PUBLIC APPOINTMENTS

### DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

#### HYDRAULICS RESEARCH STATION, WALLINGFORD, BERKS

#### SENIOR SCIENTIFIC OFFICER

D.S.I.R. Hydraulics Research Station, Wallingford, Berks, requires SENIOR SCIENTIFIC OFFICER, to investigate the mechanics of water waves, beach processes and harbour problems. Qualifications : First or Second Class Honours Degree, preferably in Civil or Mechanical Engineering, with good knowledge of Hydraulics, and at least 3 years' post-graduate experience, preferably of hydraulics research, but scientific experience in wave motion other than of water, will be relevant. Salary range £1130–£1330 (men). Prospects of promotion, and for candidates under 31 also of establishment. Good housing prospects for married staff.—Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting E 225/8A. Closing date 19 July, 1958. E7741

## ENGINEERING WORKSHOPS MANAGER

A Manager is required for the National Coal Board's Area Central Workshops in Warwickshire.

The workshops will be brought into commission early in 1959. They will be mainly concerned with the recouditioning of mining machinery and will employ 100/150 men.

Proved general engineering background and evidence of the successful application of modern production, planning and industrial managerial methods are required.

Salary within the rate £1050–£1600.

Applications, giving full details, to Area Staff Manager, National Coal Board, Lindley Lodge, Higham-on-the-Hill, Nuneaton, Warwickshire, by June 30.

E7722

## STRUCTURAL ENGINEERING DRAUGHTSMEN

required by

## MINISTRY OF WORKS

for employment in London, Scotland and Provinces on design and detailing of reinforced concrete or structural steelwork.

SALARY RANGE £550 (age 21) to £870 p.a., London (slightly less elsewhere). 5-DAY WEEK. 3½ WEEKS' ANNUAL LEAVE INITIALLY.

STARTING PAY ACCORDING TO AGE, QUALIFICATIONS AND EXPERIENCE.

GOOD PROSPECTS OF PROMOTION WITH SALARIES OF £1015 p.a. AND ABOVE.

OPPORTUNITIES FOR PERMANENT POSTS LEADING TO PENSIONS (NON-CONTRIBUTORY).

Possession of O.N.C. or equivalent an advantage.
Interviews at Regional Offices where possible.

APPLICATIONS.—State age, training and experience to Chief Structural Engineer, Ministry of Works, Room 404, Abell House, John Islip Street, S.W.1.

E7717

## ATOMIC ENERGY ESTABLISHMENT, Winfrith, Dorset.

*requires*

## ENGINEERS

*for the Design Section of the Reactor Services Group.*

**ENGINEER I** (Ref. No. W.17/25), to lead a team of Mechanical Engineers engaged in reactor design, preparation of basic specifications and layouts.
Wide experience in engineering design, heat transfer and shielding will be an advantage.

**ENGINEERS II/III** (Ref. No. W.18/25), to undertake the design and commissioning of control and instrumentation systems for research reactors and their associated experimental equipment.
Previous experience in the fields of industrial process control, electronics and telephone type circuit technique, or light electro-mechanical equipment design will be an advantage.

**ENGINEERS II/III** (Ref. No. W.19/25), to undertake the design of components for reactor and reactor buildings, together with the preparation of specifications.
Previous experience in a design office will be an advantage.

In all cases applicants should be Corporate Members of a Senior Engineering Institution or have exempting qualifications. They must also have served a recognised engineering apprenticeship or have had equivalent recognised training.

| SALARY: | | |
|---|---|---|
| | Engineer I | £1790–£2080 p.a. |
| | Engineer II | £1300–£1740 p.a. |
| | Engineer III | £815 (at age of 25)–£1270 p.a. (highest age pay £1110) |

*Send POST CARD for application form, quoting appropriate reference, to Group Recruitment Officer, A.E.R.E., Harwell, Didcot, Berks.*

E7474

## TENDERS

### THE COMMISSIONERS FOR THE PORT OF CALCUTTA

#### NEW DOUBLE LADDER BUCKET DREDGER

TENDERS are invited from experienced Bucket Dredger Builders for the CONSTRUCTION and SUPPLY of a

TWIN SCREW STERN WELL DOUBLE LADDER BUCKET DREDGER.

of the following dimensions :
Length B.P. not exceeding 175ft. 6in. (53·50 metres).
Breadth moulded, not exceeding 44ft. (13·40 metres).
Depth 17ft. 9in. (5·41 metres).
Draught approximately 13ft. 6in. (3·81 metres).
Speed at maximum draught 9·5 knots at 4/5ths power.

Drawings, specifications and conditions of contract may be obtained by Shipbuilders from the Commissioners' Consulting Engineers, Messrs. Rendel, Palmer and Tritton, 123, Victoria Street, Westminster, London, S.W.1, on payment of a deposit of Rs.25,000 or £1875 Sterling, returnable on adjudication. Applications from Agents or other intermediaries will not be considered.

Tenderers are required, on submitting their Tenders, to enclose with their specifications and drawings, proof of their recent experience in building dredgers of this particular type.

Tenders, in sealed envelopes, endorsed on the outside "TENDER FOR NEW DOUBLE LADDER BUCKET DEREDGER," are to be submitted, in triplicate, of which one copy is to be addressed to :—

The Deputy Conservator,
The Commissioners for the Port of Calcutta,
15, Strand Road,
CALCUTTA,
India.

and two copies addressed to :—

Messrs. Rendel, Palmer and Tritton,
Consulting Engineers,
125 Victoria Street,
Westminster,
LONDON,
S.W.1.

The Tenders must reach the Deputy Conservator not later than 1700 hours I.S.T. on the 22nd September, 1958, at Calcutta, and the Consulting Engineers not later than 1130 hours G.M.T. on 22nd September, 1958.

Quotations from the Tenderers must be firm and remain open for a period of fourteen weeks from the closing date.

The Commissioners do not bind themselves to accept the lowest of any Tender and reserve the right to reject a Tender without assigning any reasons.

(Sgd.) Deputy Conservator,
CALCUTTA PORT COMMISSIONERS.

E7439

Classified Advts. continued on page 108

## TENDERS

### DUNMOW RURAL DISTRICT COUNCIL

**HIGH EASTER, HIGH RODING AND WHITE RODING**

**SEWERAGE AND SEWAGE DISPOSAL**

**CONTRACT NO. 13**

TENDERS are invited on a fixed price basis, in accordance with the Ministry of Housing and Local Government Circular No. 31/57, for the CONSTRUCTION of SEWERAGE AND SEWAGE DISPOSAL WORKS at High Easter, High Roding and White Roding.

A sewage disposal works is to be constructed at each of the above-mentioned villages and will comprise pyramidal sedimentation tank and humus tank, biological filter, concrete slude digestion tank, sludge drying beds, stormwater irrigation area, pumping station, ancillary pipework, access roads and paths.

The sewerage comprises in all the laying of about 1300 lin. yd. of 9in. diameter S.G.W. sewer, 6000 lin. yd. of 6in. diameter S.G.W. sewer, 800 lin. yd. of 4in. diameter spun iron rising main, 4in. and 6in. diameter S.G.W. house connections, construction of 16 brick and 57 precast concrete manholes, together with three subsidiary sewage pumping stations in reinforced concrete.

General conditions of contract, specification, bills of quantities and drawings may be obtained from the Council's Consulting Engineers, Messrs. J. D. and D. M. Watson, MM.I.C.E., 67, Tufton Street, Westminster, S.W.1, on and after 7th July, 1958, on payment of a deposit of 10 guineas, refundable only to contractors who submit bona-fide Tenders and return all documents and drawings. Deposit cheques should be made payable to Dunmow Rural District Council.

The Council do not bind themselves to accept the lowest or any Tender.

Tenders must be returned in envelopes which do not bear any name or mark indicating the sender, endorsed "Tender for Sewerage Contract 13," and delivered at the office of the undersigned by noon on 30th August, 1958.

A. H. BURTON,
Clerk of the Council.

Dunmow Rural District Council,
Council Offices,
Dunmow, Essex. E7742

### INDIA STORE DEPARTMENT

**AUTOMATIC PICKLING UNIT**

The Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of: AUTOMATIC PICKLING UNIT for pickling and washing of 70/30 brass cartridge cases, 6in. diameter × 30in. long, output 85 cases per hour, each weighing 16 lb.

Tender schedules and specifications may be obtained from the above address at a fee of ten shillings, which is not refundable. Cheque should be made payable to "High Commission of India." The application for Tender forms should state reference 2332/57/OPV/ENG.3.

Tenders, complete with specifications, to be submitted by Monday, the 18th August, 1958. E7473

### COUNTY BOROUGH OF BLACKBURN

TENDERS invited for the SUPPLY and DELIVERY of GOODS required for Phase II (mainly Science) of a new Technical College :—(a) Movable Furniture (i) Wooden, (ii) Steel. (b) Apparatus and Equipment for : (i) Chemistry, (ii) Physics, (iii) Biology, (iv) Photography. (c) Machinery and Tools for Physics Workshop. (d) Visula and Aural Aids. (e) Bakery Apparatus and Equipment (i) Light, (ii) Heavy.—Forms of Tender obtainable from the Chief Education Officer, Library Street, Blackburn, returnable to me by 8th July, 1958.

FRANK SQUIRES,
E7743 Town Clerk.

## EDUCATIONAL

**A.M.I.MECH.E., B.Sc.,** City and Guilds, &c. Guarantee Postal Courses for all Exams., and Technical Divisions from Elementary to Degree standard. Approximately 95 per cent. successes. 144-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 E

### UNIVERSITY OF DURHAM

**KING'S COLLEGE, NEWCASTLE UPON TYNE**

**RAMBUSH STUDENTSHIP**

Applications are invited for the above-mentioned STUDENTSHIP, of the value of £350 per annum, which is available annually for postgraduate research in the Department of either Chemical, Mechanical or Civil Engineering, as a result of a gift from the Power-Gas Corporation, Limited, in commemoration of the late Dr. N. E. Rambush.

The Studentship is open to graduates of approved Universities, or candidates hoping to graduate in June, 1958. It is tenable for two years, but may be renewed for a third year in special circumstances.

Forms of application and further particulars may be obtained from the undersigned, to whom completed application forms should be returned as soon as possible.

G. R. HANSON,
Registrar of King's College.
May, 1958. E7690 E

## EDUCATIONAL

**FREE!** Brochure giving details of Courses in Mechanical and Production Engineering, Draughtsmanship, &c., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other professional examinations. —E.M.I. Institutes, Dept. E.30, London, W.4. (Associated with H.M.V.) E117 E

### U.K.A.E.A.

**Harwell Reactor School**

The next standard course on which places are available commences on 10th November, 1958, and ends on 6th March, 1959.

The fee for the course is £250 exclusive of accommodation.

Application forms and further details can be had from :—

The Principal,
Reactor School,
Atomic Energy Research Establishment,
Harwell,
Didcot,
Berkshire.

E7688 E

## SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES, NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

**A MEDIUM-SIZED GENERAL ENGINEERING COMPANY** in the North West of England desires to appoint a top-grade man to take complete charge of the Process Planning, Ratefixing and Jig and Tool Departments. The successful applicant must hold a comparable post, possess a sound knowledge of engineering and be capable of controlling staff. The company is a progressive one and a generous superannuation and life assurance scheme is in operation. Please give full details of age, education, experience, salary required, &c.—BOX No. E7478, "The Engineer." A

**A SENIOR POWER ENGINEER** position is open in the Engineering Department of a major oil Company based in London, but necessitating occasional visits overseas.

Candidates for this position must be under forty years of age and have had several years of experience in the design of thermal power stations, both from the steam and power generation sides, and be familiar with the design and layout of the distribution systems required to cover large installations.

A generous salary commensurate with qualifications and experience can be offered.—Apply, with fullest particulars, age, qualifications, experience, &c., to BOX No. E7693, "The Engineer." A

**A VACANCY EXISTS** in the Middle East with a large and well-known organisation for a SERVICE ENGINEER who is fully qualified to install and service a full range of refrigeration and air-conditioning plants and equipment. Previous experience planning and installation is essential and a knowledge of American plant and equipment is desirable. The position is permanent and has good prospects for advancement. The commencing salary would not be less than £1000 per annum, with a local allowance whilst in the Middle East of £780 per annum. Pension fund. Free passages and free furnished accommodation. Generous family allowances.—Apply, giving full particulars, to BOX No. E7724, "The Engineer." A

**AN INTERESTING OPPORTUNITY** exists for a young GRADUATE ENGINEER having drive and initiative to assist in the development of new and existing products in the Boiler and General Engineering Division of an established and progressive firm of heavy engineers in East Anglia. Previous experience of steam or refrigeration work an advantage, but not essential. Good prospects to the right applicant. —Apply, giving full particulars of qualifications and experience, to BOX 3B R.6388, A.K. Advg., 212a, Shaftesbury Avenue, London, W.C.2. E7756 A

**APPLICATIONS ARE INVITED** for the following appointment at the CLAYDON, SUFFOLK, Works of THE BRITISH STEEL PILING CO., LTD.

SENIOR DESIGNER DRAUGHTSMAN (Minimum qualifications H.N.C. or equivalent).

Age group 28–35 years. Candidates should be capable of accepting responsibility for complete projects.

THIS APPOINTMENT IS PERMANENT AND PROGRESSIVE IN AN EXPANDING ORGANISATION and the successful candidate will be engaged on interesting work in connection with special crane type structures, hoisting machinery (steam, diesel, electric) and contractors' plant.

Contributory pension scheme in operation. Good canteen facilities. Salary in accordance with qualifications and experience. Holiday arrangements respected. The Works are situated 15 minutes bus ride from the centre of Ipswich.—Applications to the Personnel Officer at the above address. E7711 A

## SITUATIONS VACANT

**A.P.V.** require a BREWERY EQUIPMENT SALES ENGINEER for their Australian Associated Company. A Chemical or other Engineer with a knowledge of the brewing processes would be suitable. Selected applicants will be required for interview in London in August by the Australian Director. —Apply to the Managing Director, The A.P.V. Company, Ltd., Crawley, Sussex. E7700 A

**ASSISTANT ENGINEERING LECTURER** required for Cadet Training Course on modern refrigerated cargo motor liner fitted out for the purpose plying between the United Kingdom and Australia or New Zealand. In conjunction with the Senior Lecturer in charge, duties will include the teaching of thirty cadets (in two classes) studying on a two-year course for Part 1 of the Engineering Institutes Examination, and applicant will also be expected to take part in the social life of the officers and cadets, both ashore and afloat. The applicant should be not more than 40 years of age, have graduate qualifications and at least four years' teaching experience in a technical college or similar institution. Full pension facilities available.—Apply to the Superintendent Engineer, New Zealand Shipping Co., Ltd., Royal Albert Dock, London, E.16, giving usual particulars, experience, &c., and state salary required, before July 16th, 1958. E7450 A

**ASSISTANT ERECTION MANAGER** required by North East Coast Plate Fabricating Company. Experience in the erection of large diameter oil storage tanks, and large bore heavy pipes an advantage. Salary offered will be in the order of £1250 per annum, plus bonus. Car provided. Address replies to General Manager.—BOX No. E7482, "The Engineer." A

**ASSISTANT SITE ENGINEERS** with experience of setting out and general site engineering duties on a variety of important contracts in the British Isles. A Civil Engineering Degree or the equivalent is desirable but not essential.

Those interested should write to :—
Personnel Manager (Ref.: A.S.E.I.),
JOHN LAING AND SON LIMITED,
London, N.W.7. E130 A

**ASSISTANT TO COMPRESSOR SALES MANAGER**

COMPRESSORS.—Personal Assistant required for Compressor Sales Manager. Previous selling experience not essential, but sound knowledge of all types of compressors and an ability to meet prospective customers and discuss specification, installation and other technical problems desirable. Salary fully commensurate with qualifications and experience.—Write, marking envelope "CONFIDENTIAL," to Compressor Sales Manager, Worthington-Simpson, Ltd., Newark, Notts. E7716 A

**BRITISH NYLON SPINNERS**

invite applications from Corporate and Graduate Members of the Institution of Mechanical Engineers for research and experimental work requiring original thought and ideas.

The work covers a wide field of problems in Machine Dynamics, Heat Transfer and Control Systems aimed at the modification and improvement of machinery and equipment.

The expanding markets for Nylon Yarn demand an accelerating programme of research to increase production and raise standards of quality.

This provides a challenge for capable engineers which, in a stable industry, offers good prospects in an inevitably expanding team.

The works are attractively situated and applicants are invited to pay exploratory visits to meet the Engineering Staff, discuss the work and see the living conditions.

Conditions of employment are of the highest. Rented houses may be available to married staff coming from outside this area.

Applications should be made to Personnel Manager, British Nylon Spinners, Pontypool, Monmouthshire. E7422 A

**CHEMICAL ENGINEER** required to act initially as an Assistant to the Chief Engineer of a medium-sized plate fabricating company situated on the North East Coast. It is envisaged that the successful applicant will eventually initiate a Chemical Plant Design Department in London or Home Counties. Experience in the operation of chemical plant as well as design ability is essential. Commencing salary, £1500 per annum. Replies to be addressed to General Manager.—BOX No. E7480, "The Engineer." A

**CHIEF ENGINEER** required by London Consulting Engineers, to take full charge of established Northern Branch Office with staff of 25, salary £1700 per annum, rising by three annual increments to £2000 per annum, and according to merit thereafter. Work mainly reinforced concrete and some structural steel. Applicants to be A.M.I.C.E. or A.M.I.Struct.E., age 30–45, experienced in responsible senior positions as designers and executives in charge of large work, including meeting clients, liaison with architects and all correspondence. Pension scheme (and assistance with housing) available. Applications, stating experience and names of past employers, which will be treated as strictly confidential.—BOX No. E1933, "The Engineer." A

**CIVIL ENGINEERING ASSISTANTS**—Junior and Senior—required by Consulting Engineers, for the design of works of water supply and/or sewerage. —Applications, stating age, qualifications and experience, to Rofe and Raffety, 3, Victoria Street, London, S.W.1. E1937 A

## SITUATIONS VACANT

**COMPUTER ENGINEER**

Boots Pure Drug Company, Limited, wish to appoint a Graduate Engineer, preferably under 35 years of age, with an Honours Degree in Light Current Engineering or allied subjects, and experience in electronic data processing or some related field.

The company is embarking on the installation of an extensive commercial electronic data processing system. Equipment on order includes a large-scale, general-purpose digital computer, a special-purpose electronic sterling accumulator, and a wide range of peripheral equipment, including a character recognition device. The system is due for installation during 1959. Development of the Data Processing Centre is expected to continue for some years.

The successful candidate will be responsible for liaison with the manufacturers before and during the installation period. He will be required to set up a small specialist team for the testing and maintenance of the equipment now under development and construction at the makers' works and for the co-ordination of these projects from the engineering and maintenance viewpoint. Training, as necessary, will be arranged for the selected candidate. The post is a senior one and the computer engineer will be responsible directly to the Chief Engineer. A generous salary will be paid commensurate with qualifications, age and experience.

Applications should be submitted by the 30th June to the Personnel Manager, Boots Pure Drug Co., Ltd., Station Street, Nottingham. E7449 A

**DE HAVILLAND PROPELLERS, LIMITED**

urgently require

a

SENIOR DEVELOPMENT ENGINEER

for a new

ENVIRONMENTAL TEST FACILITY

for LRBM Components

about to be set up at one of our

Southern factories

The applicant selected for this appointment will be responsible to the Chief Development Engineer for the setting up and subsequent operation of the Facility.

He should possess a Degree in Electrical or Mechanical Engineering, or equivalent qualifications.

He must have had considerable experience of this form of test work and should preferably have been concerned with the design layout and procurement of Environment Test Equipment.

This is a senior appointment offering considerable scope for initiative and excellent prospects for advancement in a rapidly expanding department.

Accommodation will be available.

Please write to the Personnel Manager (ref. 171),
DE HAVILLAND PROPELLERS, LIMITED,
37/39, John Street, Theobalds Road,
London, W.C.1. E7689 A

**DESIGN ENGINEER**

required to join a small group engaged on Design-for-Production of mechanisms. A.M.I. Mech.E. or equivalent. Knowledge of and interest in kinematics. Mathematical ability and ingenuity necessary.

Pleasant rural location just west of Birmingham boundary. Monthly staff, good salary and other conditions.

Applications should be addressed to Mr. D. N. Walker, Wilmot Breeden, Ltd., Amington Road, Birmingham, 25. E7757 A

**DAVY AND UNITED ENGINEERING COMPANY, LIMITED,** invite applications for the following staff vacancies in their Steelworks Construction Department, which is engaged in the engineering and supply of complete installations for the steel and metal-producing industries at home and abroad.

ASSISTANT CIVIL ENGINEER, familiar with the layout of heavy reinforced concrete foundations and services for rolling mill plant and buildings forming part of major steelworks construction projects. The position offers excellent prospects to a man having minimum qualifications of H.N.C. and preferably having passed Parts 1 and 2 of the examination for Associated Membership of the Institution of Civil Engineers.

PROGRESS ENGINEER : applicants should have broad technical experience in the heavy engineering industry and have a strong personality to ensure that visits to suppliers and sub-contractors be effective in obtaining adherence to programmes and the required standard of workmanship in compliance with our specifications.

Good conditions, contributory superannuation scheme, existing holiday arrangements honoured.

Apply in writing, with details of age, experience, qualifications and salary range, in confidence, to : Personnel Department, Davy and United Engineering Co., Ltd., Darnall Works, Sheffield, 9. E7691 A

## BOOKS and PUBLICATIONS


*Just Published*

***Pumps, Fans and Compressors***

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This book deals with the design, construction, and operation of centrifugal and axial-flow pumps, fans, and compressors. It has a practical bias and assumes a knowledge of the fundamental laws of hydraulics, aerodynamics, and thermodynamics. Specialists in these three sciences, and others who have to operate machines, will find it of considerable interest.

It was first published in French in 1953 but the authors have thoroughly revised the material for the translation into English. *45s. net*

*Prospectus from:* 17 STANHOPE STREET, GLASGOW, C.4

**BLACKIE & SON, LTD.**

**PITMAN**

*TECHNICAL BOOKS*

**THE PRACTICAL ENGINEER POCKET BOOK**
Edited by N. P. W. Moore, B.Sc., A.C.G.I., etc. Here is the sixty-sixth edition of this ever-popular pocket book. With over 700 pages, it provides the engineer with a wealth of ready and useful information which can be obtained almost at a glance. 12s. 6d. net.

**A MANUAL OF TIME AND MOTION STUDY**
By John W. Hendry, F.R.Econ.S., F.C.I.M., etc. Fifth Edition. The new edition of this well-known work forms an up-to-date summary of current practice in the subject. It makes a valuable contribution to the problem of how to raise the standard of efficiency in industry in two directions: first, by giving an incentive to workers to do their best; and second, by avoidance of all preventable waste. 21/- net.

**WORK MEASUREMENT AND INCENTIVES**
By D. J. Lintern, B.A., etc., and R. J. S. Curtis, B.A., etc. Direct in approach and basic in its treatment of technicalities, this is the first book to provide a suitable introduction to the subject for students. 25/- net.

**SOLUTION OF PROBLEMS IN STRUCTURES**
By W. T. Marshall, B.Sc., Ph.D., M.I.C.E., etc. Here is the first book of its kind to use such a direct and practical approach to the subject. In it are over 350 worked and unworked examples (with answers) of the kind of problem that the degree student will meet in examinations. 27/6 net.

**CONSTRUCTION OF GRAPHS AND CHARTS**
By A. S. Hall. Nowadays, graphic methods of presenting data and information are of great importance and offer many advantages. This new book sets out those fundamental ideas on which to base the choice of the best graph for a particular purpose. It is of great interest to all engaged in the presentation and analysis of data. 25/- net.

Parker St., Kingsway, London, W.C.2

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*Edited under the direction of the Editor of "The Engineer"*

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## SITUATIONS VACANT

**DRAUGHTSMAN** required for marine work, principally concerned with layouts for tenders for the installation of machinery and control gear in ships. Interview to suit applicant, including Saturday morning.
Apply to:
Manager, Drawing Offices (Ref. AEB/11), British Thomson-Houston Co., Ltd., Rugby. E7475 A

**ELECTRICAL ENGINEER** required by old-established company. Preference will be given to those who have technical and commercial experience and have passed either the National or Higher National Certificate. The successful applicant will be required to sell a wide range of electrical equipment for heavy and light industry. There are excellent opportunities for advancement. Superannuation scheme. Write, giving details of age, experience and salary required. —BOX No. E7758, "The Engineer." A

**ELECTRICAL OR MECHANICAL ENGINEER** wanted by large German company for German-English translations. Applications are invited from British-trained engineers with a good knowledge of German who have an inclination towards translation work and desire to work in a pleasant environment in Germany for at least 2 to 3 years. Write, stating age, education, experience and salary.—BOX No. E1939, "The Engineer." A

**ENGINEER** (Mechanical). Applications are invited from Engineers, not over 35 years, who possess 1st Class M.O.T. Certificate (Steam). Willing to reside in or near London for duties in that area and to undertake three-monthly tours of inspections of boilers, pressure vessels, &c., in West Africa. Salary in accordance with age, previous experience, if any, plus expenses and allowances. Non-contributory pension scheme.—Apply in own handwriting to BOX No. E7380, "The Engineer." A

**ENGINEER (MECHANICAL)** required for a progressive staff position carrying some responsibility for the engineering design of chemical plants, pilot scale at first The work may be quite varied, including design of special apparatus for exploratory investigations, and the design of equipment incorporating new techniques. Good qualifications are essential, and some experience. Contributory superannuation scheme. London, S.W. Write.—BOX No. E7701, "The Engineer." A

**ENGINEER REQUIRED** for maintenance and general duties in expanding company producing synthetic resins. Previous experience of chemical plant desirable. Age 25–40. H.N.C. or equivalent. Good conditions. Housing available in New Town. —Apply, Chief Engineer, REVERTEX, LTD., Harlow, Essex. E7692 A

**ENGINEERING SALES** and/or CONTRACTS ENGINEERS required by progressive company in Essex. Practical experience of machinery installation or service work in the field, and technical education to at least O.N.C. Reply, stating training and experience in chronological order, age, details, present post and salary level expected, to BOX 3B R6105, A.K. Advg., 212a, Shaftesbury Ave., London, W.C.2. E7703 A

**ESTIMATING ENGINEER** (experienced in boiler work) for progressive position with prominent London firm of land and marine boiler engineers. Attractive salary, commensurate with experience and qualifications. Write fully, stating age, &c.—BOX No. E7706, "The Engineer." A

**ESTIMATOR REQUIRED** with considerable experience of plate fabrication. Ability to work quickly and accurately is essential. This vacancy occurs in the works of a medium-sized plate fabrication company situated on the North East Coast. Salary offered would be in the region of £1100 per annum. Address replies to General Manager.—BOX No. E7481, "The Engineer." A

**EXPERIENCED FOREMAN BLACKSMITH** required by large Midland steel works. Good general smithing experience is essential and some knowledge of modern chain welding practice would be desirable. This is a staff position with contributory superannuation and life assurance benefits. Please apply, giving details of past experience, age and salary required.—BOX No. E7441, "The Engineer." A

**FACTORY MANAGER** required for small manufacturing unit in Eire, to be responsible for supervision of staff, plant maintenance, production planning, &c. An engineering background and a good standard of general education are required, together with the ability to interpret and implement management policy independently. Age limits 25/45. Superannuation scheme is in operation. Write, giving full details of experience and salary required, quoting reference F.M.—BOX No. E7718, "The Engineer." A

**FERODO LIMITED,** Brake Lining Manufacturers, Chapel-en-le-Frith, have the following vacancies:
1. SENIOR DESIGN DRAUGHTSMAN, experienced in machine design and works layouts. A knowledge of works building design desirable but not essential. Technical education to at least O.N.C. standard.
2. PROJECT ENGINEERS, over 28 and having H.N.C. minimum qualification, for the Development Engineering Department. This is a senior staff appointment and candidates must have had experience in one or more of the following subjects:
Special Plant Design, Heating, Ventilating and Dust Collection, Production Engineering and Plant Layouts, Factory Mechanical Services Layouts.
They will be responsible for handling the projects through initial investigation, preparation of estimates and reports, ordering plant and equipment and arranging for installation.
Some assistance will be given with regard to house purchase in cases of successful applicants who are married.—Write, giving details of experience and stating age and present salary, to the Personnel Manager. E7713 A

**GRADUATE IN MECHANICAL OR CHEMICAL ENGINEERING** required about September for interesting investigations into combustion in diesel engines. Previous knowledge desirable, but not essential, as adequate time will be allowed for study. Commencing salary up to £1200 p.a., according to qualifications and experience.—Apply now to Secretary, British Internal Combustion Engine Research Association, 111–112, Buckingham Avenue, Slough, Bucks. E7472 A

**FOOD PRODUCTION COMPANY** of international importance requires Graduate or young, practical and technically trained men as ASSISTANT ENGINEERS. Must be prepared to accept position in any part of the United Kingdom. Good salary, working conditions and excellent prospects of promotion. Apply, Reference I.H.C.—BOX No. E7705, "The Engineer." A

**MELTING SHOP SHIFT MANAGER** required for large steelworks in the Midlands. Applicants, aged 30–40, should have a metallurgical training with experience of operating open hearth basic process. Salary according to experience and qualifications. Pension and free life assurance schemes in operation. Full details of age, experience and qualifications.—BOX No. E7726, "The Engineer." A

**METHODS ENGINEER**

An Engineering Works within easy access of Warrington requires a keen and energetic METHODS ENGINEER, who will be responsible to Management for all Process Planning and Rate Fixing in the manufacturing sections. In addition to well-equipped modern machine shops, there are sheet metal and light structural sections feeding the Fitting and Assembly shops.

The position calls for up-to-date experience on rate fixing and time study, ability to lead a team and enthusiasm to play a part in the expanding activities of a thriving concern.

A salary will be paid which is adequate for the responsibility and sufficiently attractive to the right person.

Full particulars of education, training and experience should be sent to BOX No. 729, R. Anderson (Advertising) Co., Ltd., 14, William IV Street, Strand, W.C.2. E7715 A

**MIDLAND COMPANY** engaged in Cold Rolling Bright Steel Strip, requires SALES REPRESENTATIVE for London. Must be experienced in the trade. Full details of past experience and connections together with salary required, to be stated.—BOX No. E1936, "The Engineer." A

**PLANT ENGINEER** required by important British shipbuilding and repairing company in Hongkong. Age about 35. Should have had responsible experience of design, construction and operation of shipyard machine tools. Would be responsible for installation, layout and maintenance of air and hydraulic pipe systems, shop and yard cranes, rail tracks and general yard equipment. Knowledge of road and building construction and maintenance desirable. Good salary, free housing, generous leave, staff provident scheme, including non-contributory retirement fund.—Applications, giving full particulars of education, technical training, experience, age, family.—BOX A.483, c/o Streets, 110, Old Broad Street, E.C.2. E7428 A

**PRODUCTION ENGINEER** with Specialist's knowledge of Automatics, wanted by Midland firm. Applicant must be conversant with Wickmans, B.S.A., Acme Gridley, Brown and Sharpe and Brown and Ward's automatics. Experience on servicing, planning, tool design, tooling up and control essential. Apply, stating full details, education, age, experience and salary range.—BOX No. E7727, "The Engineer." A

**QUALIFIED MECHANICAL ENGINEER** (British or Indian National) required by large tea company in Upper Assam. Candidates should be under 35 years of age, single or married, and qualifications should include knowledge of general workshop practice, maintenance of medium-powered diesel engines and small A.C. electric generating stations. Draughtsmanship an advantage. Minimum starting salary according to qualifications, £900 p.a., subject to revision after one year's satisfactory service. In addition, generous cost-of-living allowance, free furnished quarters, servants, conveyance allowance, and medical attention. Compulsory superannuation scheme. Passage to destination paid by company. Leave on full pay, to U.K. at regular intervals, passage paid, for British personnel, and to India annually for Indian nationals.—Application should be made in writing, giving full details of qualifications and experience, to BOX "K.D.," c/o J. W. Vickers and Co., Ltd., 7/8, Great Winchester Street, E.C.2. E7414 A

**REINFORCED CONCRETE DESIGNERS** required for 2–3 years' contract in Newport, Mon, area. Salary up to £1200 for right man.—Write, giving details of experience, to BOX A.523, c/o Streets, 110, Old Broad Street, E.C.2. E7755 A

**SENIOR DESIGNER/DRAUGHTSMAN** required for steelworks consultants. Steelworks experience desirable but not essential. The position is a progressive one and salary will be dependent on qualifications and experience. Non-contributory pension scheme after satisfactory period of employment. Applications, giving age, qualifications and experience.—BOX No. E7728, "The Engineer." A

**SENIOR EXECUTIVE** required with thorough drawing-office and works experience in heavy general and rail traction engineering. Competent deal expertly considerable volume correspondence. Aged 35–50. Apply in handwriting.—BOX No. E7738, "The Engineer." A

**SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN** required for plant layout and design. General engineering experience desired. Knowledge of rolling mills, conveyors, mechanical handling or furnaces would be advantageous. Salary commensurate with experience. Interviews arranged to suit applicant.—Please write or telephone to Chief Draughtsman, General Engineering Dept., Northern Aluminium Co., Ltd., Rogerstone, Mon. (Tel.: Newport 59991/6). E7753 A

**SENIOR STRUCTURAL DESIGNERS AND ARCHITECTURAL DRAUGHTSMEN** with experience in reinforced concrete design, required for plant installations, industrial buildings and offices. Interviews arranged to suit applicant.—Please write or telephone to Chief Draughtsman, General Engineering Dept., Northern Aluminium Co., Ltd., Rogerstone, Mon. (Tel.: Newport 59991/6). E7752 A

**SPECIAL PURPOSE MACHINE AND GENERAL ENGINEERING DESIGNER DRAUGHTSMAN REQUIRED,** must be capable of working on own initiative.—Please apply, stating previous experience, qualifications and salary required, to Personnel Manager, Semtex, Ltd., Brynmawr, Brecs. E7687 A

Classified Advts. continued on page 110

## SITUATIONS VACANT

**SURVEYORS AND ASSISTANT SURVEYORS** required for work at home and overseas having some experience in the survey and profiling of routes for overhead transmission lines. Pension fund.—Apply in writing to Staff Officer, British Insulated Callender's Construction Company, Limited, 30, Leicester Square, London, W.C.2, quoting reference C/83/55. E7725 A

**TECHNICAL ASSISTANT.**—Martonair, Ltd., have a vacancy for a Technical Assistant in their Richmond Sales Office. Interesting and progressive position for a young man who has completed National Service after an engineering apprenticeship and wishes to make a career in pneumatic engineering. —Please write to Parkshot, Richmond, Surrey. E7710 A

**TECHNICAL ENGINEER** with Degree, H.N.C. or equivalent, is required for work on combustion and heavy mechanical engineering equipment. Applicant should possess initiative and experience of power station work. He will be required to carry out stress and combustion calculations with the minimum of supervision and have an understanding of estimating and electrical control diagrams. Working conditions are pleasant and a salary of approximately £1000 per annum, with superannuation benefits, will be offered to the right man. Applications with full details of experience, age, &c., should be sent.—BOX No. E7748, "The Engineer." A

**THE ELECTRICAL RESEARCH ASSOCIATION**

requires a LEADER for an existing team engaged in constructing a large automatic testing station for resistors and other electronic components at its Leatherhead Laboratories.

Applicants must be able to control a team of about 10 junior workers, and to design and supervise the construction of simple electronic and control circuits, with the associated mechanical gear. Initiative and organisational ability will be of more value than academic qualifications.

Salary will depend on age and experience, but a figure up to £1200 is offered for a suitable candidate.

Other vacancies exist for :

(1) Research into the mechanisms of failure in novel types of resistor.
(2) The collection, assessment and analysis of data on electronic component failures.
(3) Research on the effects of low temperature storage of electronic components.

For some of these vacancies recent Graduates or applicants with H.N.C. would be considered.

Applications should be sent as early as possible to :—

The Secretary,
The Electrical Research Association Laboratory,
Cleeve Road,
Leatherhead, Surrey. E7486 A

**THE VILLIERS ENGINEERING COMPANY LIMITED,** Marston Road, Wolverhampton, have a vacancy for a METHODS ENGINEER in their Gear Cutting Department. Applicants must be conversant with modern gear cutting technique for mass production and be familiar with heat treatment, inspection and testing of gears. The position is permanent, progressive and superannuated, and only candidates up to Higher National Certificate standard and having held a similar position for at least five years, will be considered.—Apply, giving age and positions held, in chronological order, to the Personnel Manager at the above address. E7485 A

**UNIVERSITY GRADUATE CIVIL ENGINEER** preferably with some site experience, required for heavy construction programme in Newport, Mon, area. Opportunity for site and drawing-office experience suitable for Institution of Civil Engineers qualifications. Starting salary £650–£700, according to experience.—Write to BOX A.522, c/o Streets, 110, Old Broad Street, E.C.2. E7754 A

**VACANCY EXISTS** in a most up-to-date Research Centre for a RESEARCH ENGINEER. Work involves practical and theoretical projects of a fundamental and thermodynamic nature associated primarily with pressure-charged oil engines. Excellent conditions and work varied and interesting. Applicants should be between 22 and 25 years of age, possess an Honours Degree in Engineering, and be Graduates of the Institution of Mechanical Engineers, or have the equivalent practical training. Posts pensionable and progressive.—Applications, stating age, qualifications and experience, to Manager, Industrial Relations Dept., Ruston and Hornsby, Ltd., Lincoln. E7471 A

**WORKS ENGINEER**

Venesta Limited require a Works Engineer for a group of factories engaged in the manufacture of Aluminium Foil, Collapsible Tubes and Plywood products.

The successful candidate will be responsible to the General Works Manager for the installation and maintenance of plant and machinery, buildings, the drawing-office, boiler house and machine shop.

Applicants should possess A.M.I.Mech.E. or an equivalent qualification and be fully experienced plant engineers.

Age—about 40.
Starting salary—£1750 to £2000 a year, plus bonus, according to qualifications.

Please write, in confidence, giving details of education, qualifications, experience and present salary, to the Personnel Manager, Venesta Limited, North Woolwich Road, E.16. E7708 A

**WORKS ENGINEER** required immediately for Chemical Works (180 employees) in Selby, Yorkshire. Post involves full responsibility for the maintenance and repair department and for the plant installation and constructional work associated with current expansion. This is an interesting and progressive post in an expanding organisation. Good working conditions, staff superannuation and bonus schemes, assistance with housing if necessary, car provided. Fully qualified chemical engineers, or mechanical engineers with similar experience in the chemical industry, age 30–40, should apply to the Managing Director, John and E. Sturge, Ltd., 1, Wheeleys Road, Birmingham, 15. E7335 A

## SITUATIONS VACANT

**STOTHERT & PITT LTD., BATH**

invite applications from

**DESIGNER/DRAUGHTSMEN**

with experience in or akin to any of the following

VIBRATING ROLLERS, QUARRYING PLANT, TRUCK MIXERS, CONCRETE MIXERS, ASPHALT PLANTS, CONCRETE BATCHING PLANTS AND ALLIED EQUIPMENT

Local interviews can be arranged but we prefer you to visit our works for a tour of inspection, when all aspects of the work can be seen at first hand. Travelling expenses will be paid to selected applicants. GOOD SALARIES will be paid based on experience and qualifications. Assistance will be given in obtaining housing accommodation where required.

General conditions of employment are excellent. Applications, in writing or by telephone, giving details of age, experience and qualifications, which will be TREATED IN THE STRICTEST CONFIDENCE, should be made to the CHIEF ENGINEER, CONTRACTORS' PLANT DEPARTMENT, STOTHERT AND PITT, LTD., BATH (Telephone : Bath 2277). E7368 A

**MECHANICAL ENGINEERING DRAUGHTSMAN**

required, approximately 23/35 years of age, with good engineering background and experience in Rubber and Plastic Moulding and Jig and Tool work. Salary A.E.S.D. plus, according to qualificattions and experience. Pension Fund. Five Day Week. Write, stating age, experience, etc., to the Personnel Officer, British Insulated Callender's Cables, Ltd., Leigh, Lancs.

E7479 A

**SENIOR DRAUGHTSMEN, DESIGN ENGINEERS**

and

**DESIGN DRAUGHTSMEN**

At our Corby Works, one of the largest integrated Iron, Steel and Steel Tube Works in Europe, we have vacancies for MECHANICAL, ELECTRICAL, CIVIL and STRUCTURAL DRAUGHTSMEN.

The vacancies exist in the New Development Drawing-Offices and the Works Drawing-Offices. The work is interesting and offers scope and opportunity to talented young men.

Applicants with Higher National Certificate and experience in either the Iron and Steel industry or heavy engineering are preferred, but men with Ordinary level and relevant experience, or even unqualified men whose experience is outstanding, would be considered.

In addition to these vacancies, there are openings in other Drawing-Offices elsewhere in the Company.

Five-day week. Good welfare, canteen and recreation facilities. Superannuation and life assurance scheme. Staff hostel for single men. Favourable local housing conditions.

GOOD SALARIES BASED ON EXPERIENCE AND QUALIFICATIONS.

Applications will be treated as confidential and should be made, giving details of age, qualifications, experience, and salary required, to :

Manager/Personnel,
STEWARTS AND LLOYDS, LIMITED,
CORBY, Northants.

E123 A

## SITUATIONS VACANT

**THE NUCLEAR POWER PLANT COMPANY LIMITED**

requires

**ENGINEERS**

to work on the co-ordination of projects, the design of services and the layout of plant and buildings, for Nuclear Power Stations.

Applicants must have an Engineering Degree or be Corporate Members of a recognised Institution, and have had experience of either power station or heavy chemical engineering work. Further experience in control and instrumentation will be an advantage.

The Company operates a contributory pension scheme, and assistance with house purchase is given to married men.

Applications, stating age, qualifications and experience, should be addressed to :

The Secretary,
The Nuclear Power Plant Co., Ltd.,
Booths Hall, Knutsford, Cheshire,

quoting reference E/CRD/50.

E7477 A

ELECTRO METHODS LTD OF STEVENAGE

Manufacturers of Scientific Instruments and Electrical Apparatus invite applications for the position of

**CHIEF ENGINEER**

The successful applicant will be required to control and expand teams of engineers engaged in the design and development of electro-mechanical devices, magnetic amplifiers and servo systems.

This is an excellent opportunity for a man holding an engineering degree and with particular experience in this field of industry.

A high salary will be offered for this position.

Superannuation scheme in operation and housing available in Stevenage New Town.

Applications will be treated in strict confidence and should be addressed to :—
The Managing Director, Electro Methods Ltd.,
Caxton Way, Stevenage, Herts. E7698 A

**Dunlop Rubber Company Ltd.**

*have vacancies for*

**ASST. ENGINEER/BUYERS**

*in the*

**CENTRAL PURCHASING DEPARTMENT, FORT DUNLOP, BIRMINGHAM, 24**

Engineers holding at least Ordinary National Certificate in Mechanical Engineering or a similar qualification, are invited to apply for two appointments, initially as Assistant Buyers in the Engineering and Standards Section of the Department. The Section is responsible for purchasing all types of engineering plant, tools and machinery for the Company's overseas factories and for the production of engineering and allied Buying Standards. The positions offer opportunities for advancement in a newly created division of the Company to engineers in the 25 to 35 age group who wish to broaden their technical training with some commercial experience. Preference will be given to applicants with some experience of rubber working machinery.

The posts are pensionable staff appointments in good working conditions and the Company provides excellent welfare and sports facilities.

Please write, in confidence, giving age, experience and commencing salary expected, to the PERSONAL MANAGER (C.P.), FORT DUNLOP, ERDINGTON, BIRMINGHAM, 24.

E7484 A

## SITUATIONS VACANT

### CADBURY BROTHERS LTD.

HAVE VACANCIES FOR

### DRAUGHTSMEN

for plant design and layout work, with some works experience. The National, or Higher National Certificate, though not essential, would be an advantage. Five-day week, attractive working conditions, Pension Scheme. Provision of accommodation will be considered.

Apply in writing, stating age, qualifications, experience, and salary required, to :

**CHIEF ENGINEER, CADBURY BROS., LTD., BOURNVILLE, BIRMINGHAM**

E131 A

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The world's leading inventors and manufacturers of special purpose precision machinery for the Tobacco Industry have opening in their London Drawing Office for :—

### ELECTRICAL DESIGNER

Desirable applicant should be aged 25–40, with technical qualifications at least up to H.N.C. level, and with a broad background of experience in the design of electrical and electro-mechanical equipment as applied to precision machinery.

This opportunity is permanent and progressive ; it offers immediate pensionable Monthly Staff position with 3 weeks' Annual Holiday and other advantages.

Applications, stating age, qualifications and experience, should be personally addressed in confidence to G. B. Salmon.

MOLINS MACHINE CO. LTD., Evelyn Street, London, S.E.8.

E7704A

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### GENERAL DESIGN DRAUGHTSMAN

FOR

**BAHRAIN**

APPLICATIONS are invited for this position with the Bahrain Petroleum Company, Limited, from men with Higher National Certificate in Mechanical Engineering and not over 35 years of age.

Duties involve necessary design calculations for work such as positioning and sizing expansion loops in process lines, sizing of structural members for support structures, calculating stresses in pressure vessels to determine allowable wall thicknesses, &c., and applicants must have a thorough knowledge of 1st and 3rd Angle and Isometric projection drawings and of materials and methods of construction.

The commencing salary is £111.0.0. per month, in addition to which free air-conditioned accommodation and a living allowance are provided. An initial kit allowance, medical attention, paid local and home leaves are also provided with participation in pension and provident fund schemes.—Apply in writing, quoting " ETS," with full particulars of experience, to Caltex Services, Limited, Caltex House, Knightsbridge Green, London, S.W.1.

E7694 A

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### SMITHS OF ENGLAND
### STANDARDS ASSISTANT

An interesting and progressive career is open to young Engineers in the Standards Office of this Group of Companies.

Previous experience unnecessary, but some Drawing-Office experience is essential, together with O.N.C. and ability to write reports in concise English.

Write in confidence with details of age and qualifications to :

The Staff Manager,
S. Smith and Sons (England), Ltd.,
Cricklewood Works, London,
N.W.2, quoting reference SM/120.

E7702 A

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## SITUATIONS WANTED

**DESIGN AND EDITORIAL** experience in light engineering. Advertiser seeks change. Well-educated, A.M.I.Mech.E., earning £775 p.a. Southern England.—BOX No. E1926, " The Engineer." B

**QUALIFIED DESIGN AND DEVELOPMENT ENGINEER** (31) seeks change. Experienced in special-purpose machines, electro-mech. mechanisms, hydraulics, &c. Present salary £1200 p.a.—BOX No. E1941, " The Engineer." B

## BUSINESSES and PREMISES

**WHITEHALL, S.W.1** (Adjacent Trafalgar Square). Suite of 12 Offices, capable of further sub-division if necessary. Floor Area 2600 sq. ft. Good natural lighting. Lift and Central Heating. Rent £3250 per annum excl. Lease by Arrangement.—Further details from CHAMBERLAIN & WILLOWS, 23, Moorgate, E.C.2 (MET 8001). E7712 L

**BOURNEMOUTH AREA.** Substantial Commercial Premises. 22,424 sq. ft. under cover. Open yard 7000 sq. ft. Close docks and railway. Ideal many purposes. £27,500 Freehold. Would let to good tenant. REBBECK BROS., The Square, Bournemouth. E7730 L

## FOR HIRE

**LATTICE STEEL** Erection Masts (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1 (Phone, SLOane 5259). E103 K

**HIRE A £1500 CAMERA FOR ONLY £5.** All other types of photographic equipment available.—B. Bennett and Sons, Ltd., 25/27, Oxford Street, London, W.1 (Telephone, GERrard 9953). Catalogue on request. E128 K

## MISCELLANEOUS

**E.L.S.**
**" ENGINEERING LAND SURVEYS "**
Topographical Surveys for Civil Engineering and Building Projects ; Home and Overseas.
CAMBRIDGE HOUSE,
COMMERCIAL ROAD, WOKING, SURREY
Tel.: Woking 3860.
E1940 I

**TIME RECORDERS,** Sales, Rentals, Service, Telephone Hop 2239.—Time Recorder Supply and Maintenance Co., Ltd., 157–159, Borough High Street, London, S.E.1. E110 I

## SUB-CONTRACTING

**CASTINGS.**—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process ; sample castings treated ; A.I.D. approved. —Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex (Phone, Byron 1178). E109 MW

**KELLERING** and Profile Milling in all metals. Send us your die blocks to copy from wood or plaster masters. Up to 5ft. by 8ft. max. size. We are die copiers to the trade.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Tel., Knottingley 2743/4). E116 MW

**PRECISION ENGINEERS.**—Personal service for prototypes, small quantity machined parts and equipments. Design and development undertaken. A.I.D. Approved.—Bowyer, Smyth and Partners, Ltd., Vineyard Walk, Clerkenwell, E.C.1 ('Phone, TERminus 5113/4). E112 MW


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SPECIALISTS IN FABRICATED MACHINERY
GENERAL SHEET METAL WORKERS
Brake Press Capacity 8ft. × 3/16 in.
DIFFICULT JOBS OUR SPECIALITY
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Tel: AMHurst 1212

E7192 MW


## AGENCIES

**QUALIFIED MECHANICAL AND ELECTRICAL ENGINEERS,** with an established connection in South Wales and South Western Districts, are open for Engineers' Agencies, preferably for Power Plant and Heavy Engineering.—BOX No. E1931, " The Engineer." D

## PATENTS

**THE PROPRIETOR** of British Patent No. 659,952, for " AN IMPROVED BLADE AND BLADE-GUARD FOR SLICING MACHINES AND THE LIKE," wishes to arrange for commercial exploitation by Licence or otherwise in the United Kingdom. Enquiries to Wheatley and Mackenzie, 19/23, Ludgate Hill, London, E.C.4. E7732 H

## MACHINERY Etc. WANTED

**WANTED,** Machines of all Types.
CASH PAID.
Norman E. Potts (B'ham), Ltd., 130, Moseley Road, Birmingham, 12. VIC. 1278, 1279, 1270, 0856.
E104 F

**5-TON FRICTION DROP STAMP**—Massey Type. Reply.—BOX No. E1934, " The Engineer." F

## FOR SALE

### TWO NEARLY NEW POWERFUL CRANES

90-ton Electric Travelling Goliath Crane, 106ft span, 72ft. lift, all lattice steel construction, electrics 400 volts, 3-phase, 50 cycles. Tested by Lloyds to 150 tons.

35-ton Electric Portal Wharf Crane, built 1945 ; 35 tons at 60ft. fixed radius, 85ft. height of lift, rail gauge 40ft., admitting 3 lines of standard gauge track, electrics 440/3/50, with Ward-Leonard generator.

REED BROTHERS (ENGINEERING), LTD.,
Replant Works, Woolwich Industrial Estate,
London, S.E.18.
Telephone : Woolwich 7611/6.
E7735 G

**METROPOLITAN-VICKERS 500 H.P. SLIP-RING ELECTRIC MOTOR,** 196 r.p.m., 400/440/3/50 cycles, complete with control panel and reduction gearbox, giving a final speed of 8·1 r.p.m.
Motor and gearbox available separately if required.

JOHN CASHMORE, LTD.
Newport, Mon.
Tel.: Newport 66941 (6 lines).
E120 G

**CARDBOARD BOXES,** also HEAVY and WATER-RESISTING CONTAINERS—rigid, folding, plain and printed.—Charles Commissar, Ltd. (est. 1907), 12, Hanseage Street, London, E.1 ; telephone, Bishopsgate 6818. Noted for reliability. E1930 G

## FOR SALE

SERVICE EDWARDS VALUE

INCANDESCENT Forced Draft Bar Heating Furnace, double-ended, gas-fired, heating chamber 36in. wide by 24in. deep by 9in. high, total length through furnace 32in. working, temperature range 900 deg. to 1350 deg. C., 1200 deg. C. can be reached in about 1¼ hours after starting from cold.

BLISS No. 822, Automatic Strip Feed Power Press, with twin lid curling and stacker attachment, complete with double blanking and forming tools for 3in. diameter can ends, self-contained vacuum pump to strip feed, vee rope motor drive suitable for 400/3/50, fitted with detachable front tie bars, pressure exerted approximately 40 tons, stroke 3½in., size of bed 29½in. by 17½in., maximum length of strip 38in., weight approximately 5 tons 6 cwt.

TAYLOR & CHALLEN No. 3 G.D.F. Geared, Double-Sided, Double Action, Cam Action Drawing Press, arranged motor drive for 400/440/3/50, punch stroke approximately 7in., blank-holder stroke approximately 3½in., tee slotted bed 18in. by 15½in., between uprights 20½in., weight approximately 51 cwt.

BESCO High -Speed Open End Guillotine Shearing Machine, Undercrank type, arranged motor drive for 400/440/3/50, fitted with automatic sheet hold-down and complete with front, back and side gauges, capacity, mild steel 48½in. by 14 S.W.G.

B.E.N. Model TS9, 2-Stage Automatic Air Compressor Unit, comprising 2-stage vee type air-cooled compressor, arranged motor drive for 400/440/3/50, motor and compressor mounted on horizontal air receiver, displacement 9 cu. ft. per minute, working pressure 200 lbs. per square inch.

QUICKWORK No. 321, motorised Rotary Shearing Machine, with circle cutting attachment, arranged motor drive for 400/440/3/50, capacity 14 S.W.G. mild steel, depth of shear throat 30in., cuts circles from 6in. to 60in. diameter, weight approximately 18 cwt.

Photographs of the above are available.

MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

**F. J. EDWARDS, LTD.,**
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RAILWAY MATERIAL.—150 h.p. Stephenson Diesel Loco., fluid flywheel drive ; Ruston 80/88 h.p. Diesel Loco., electric start, flameproof ; Peckett 14in. by 22in. and 7in. by 12in. Steam Locos.; 3 miles 20 lb. Track, 24in. gauge bogies, turnouts, locos., &c.

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**Classified Advts. continued on page 112**

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TAYLOR & CHALLEN 1573B DOUBLE-SIDED GEARED, SINGLE CRANK, POWER PRESS, 120 tons capacity, 18in. stroke, bed area 24in. by 26in., self-contained 15 h.p. motor drive, 400/3/50.
TAYLOR & CHALLEN 1562 DOUBLE-SIDED GEARED, SINGLE CRANK, POWER PRESS, 200 tons capacity, 36in. stroke, bed area 24in. by 22½in., self-contained 30 h.p. motor drive, 400/3/50.
NEW "FICEP" STANDARD 16 UNIVERSAL COMBINATION PUNCHING, SHEARING, CROPPING AND NOTCHING MACHINE, capacities ¾in. plate, 4½in. by ½in. angles, punch ¾in. by ¾in., &c., 400/3/50.
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6-ton Rapier Standard Pet./Elec. Mobile Crane on solid rubber tyres.
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Fordson Major Diesel Tractor, complete with Horndraulic shovel equipment.

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**FOR SALE.**—H-T Terry Turbine T2B1, Type Z1, 27·5 h.p., steam 120, temperature 341 deg. F., exhaust steam 25 r.p.m., 2900, Serial No. 51/4503. Unused. Lying Birkenhead.—BOX No. E1935, "The Engineer." G

**ROSS FORK LIFT TRUCK** mounted on pneumatic tyres, 6000 lb. capacity. Complete with crane attachment. £850. Chamberlain Plant Ltd., Crown Works, Southbury Road, Enfiled, Middx. HOWard 4994. E1938 G

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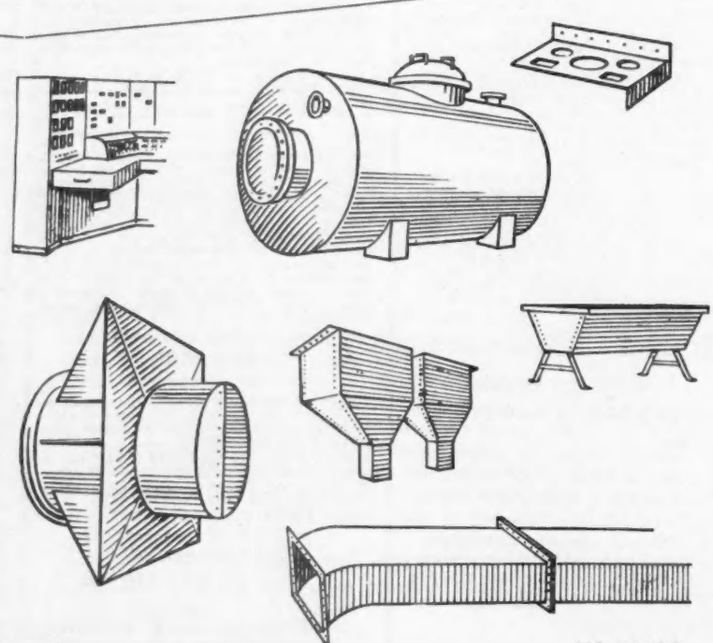

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Makers : John Musgrave and Sons, Limited.
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V3 MASERATI, New, High-speed Dial Sliding and Swivelling Head, multi-motor drive, rapid power traverse in all directions by separate motor, table working surface 59in. by 13¾in. capacity 35½in. by 11in. by 18½in., 20 spindle speeds 18–2000 r.p.m., spindle motor 10 h.p.

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*By Order of the Minister of Supply*

## GOVERNMENT SURPLUS STORES

AUCTION PROGRAMME

| | | *Main Location* | *Auctioneers* |
|---|---|---|---|
| June 24 | **Miscellaneous stores,** including textiles, M/T tools, furniture, old batteries, etc. | Northern Command Ordnance Sub Depot, **Barlow, Nr. Selby, Yorkshire.** | **BARTLE & SON** (Dept. L), 50–52, Merrion Street, Leeds, 2. (Tel.: 2.0898.) |
| June 25–27 | **Miscellaneous stores,** including cordage, tentage, hand tools, sacks, cartons, etc. | Central Ordnance Depot, **Didcot, Berks.** | **SIMMONS & SONS** (Dept. L), 12, Station Road, Reading, Berks. (Tel.: 54025.) |
| July 2–3 | **Machine tools and miscellaneous stores,** including :— | Technical Stores Depot, **Old Dalby, Melton Mowbray, Leics.** (Sale at Melton Mowbray.) | **SHOULER & SON** (Dept. L), 1, Norman Street, Melton Mowbray, Leics. (Tel.: 81.) |
| | 85 centre and capstan 5in. to 8in. lathes, miller, pillar and bench drills, arc welders, tool and cutter grinders, metal spraying compressors, caterpillar track presses, hydraulic straightening presses, hack saws, electric and other warehouse stackers, fork lift stackers and elevated platform trucks, valve refacers, engine belting, bench, pedestal and flex shaft grinders, hearths and furnaces, gravity conveyor rollers, steel wire rope, fire extinguishers, stencil cutters, scales and weighing machines, scratch brushes, sack barrows, strapping steel and wire, lathe chucks and spares, test instruments, steel pallets, calico sheeting, camouflage netting, wax, paint, linseed oil, etc. | | |
| July 7–11 | **Passenger and load-carrying vehicles, earth-moving and lifting equipment and their ancillaries and spares.** | M.O.S. Storage Depot, **Ruddington, Notts.** | **WALKER, WALTON & HANSON** (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 47271.) |
| July 15–16 | **Vehicles, machine tools and miscellaneous stores,** including M/T spares, etc. | Central Ordnance Depot, **Bicester, Oxon.** | **MIDLAND MARTS, LTD.** (Dept. L), Market Square, Bicester, Oxon. (Tel.: 73.) |
| July 24 | **Miscellaneous stores.** | M.O.S. Storage Depot, **Rotherwas, Hereford.** | **RUSSELL, BALDWIN & BRIGHT, LTD.** (Dept. L), 20, King Street, Hereford. (Tel.: 4366.) |

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Tenders must be submitted by July 7 for (1) and (2). For (3), application for tender forms must be received by July 4.

Applications for tender forms, *stating which tender is required*, should be made to the Ministry of Supply, Directorate of Disposals, First Avenue House, High Holborn, London, W.C.1.

E118 J

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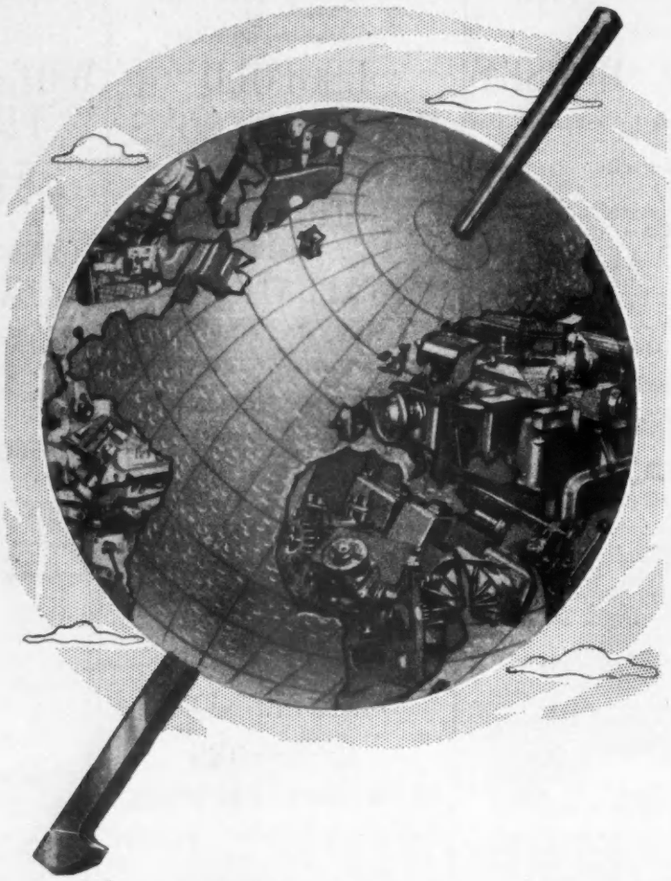

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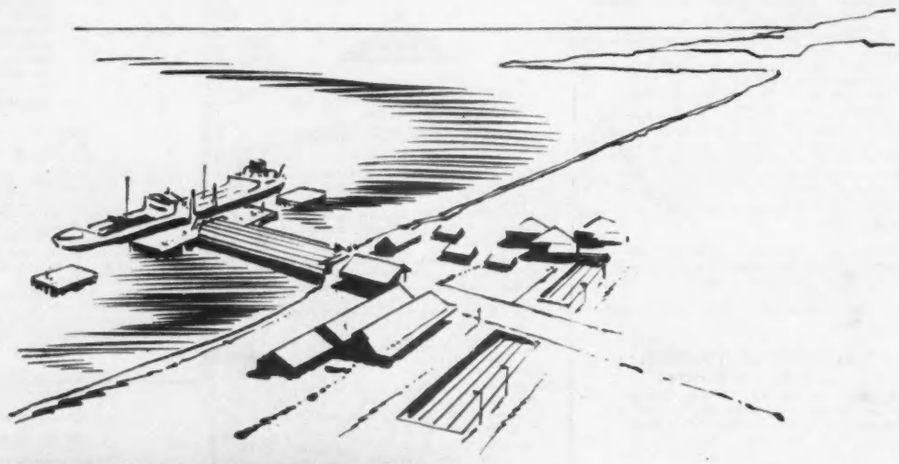

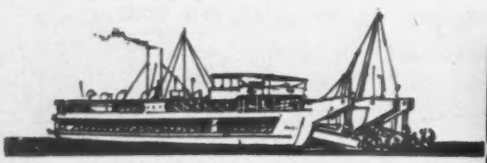

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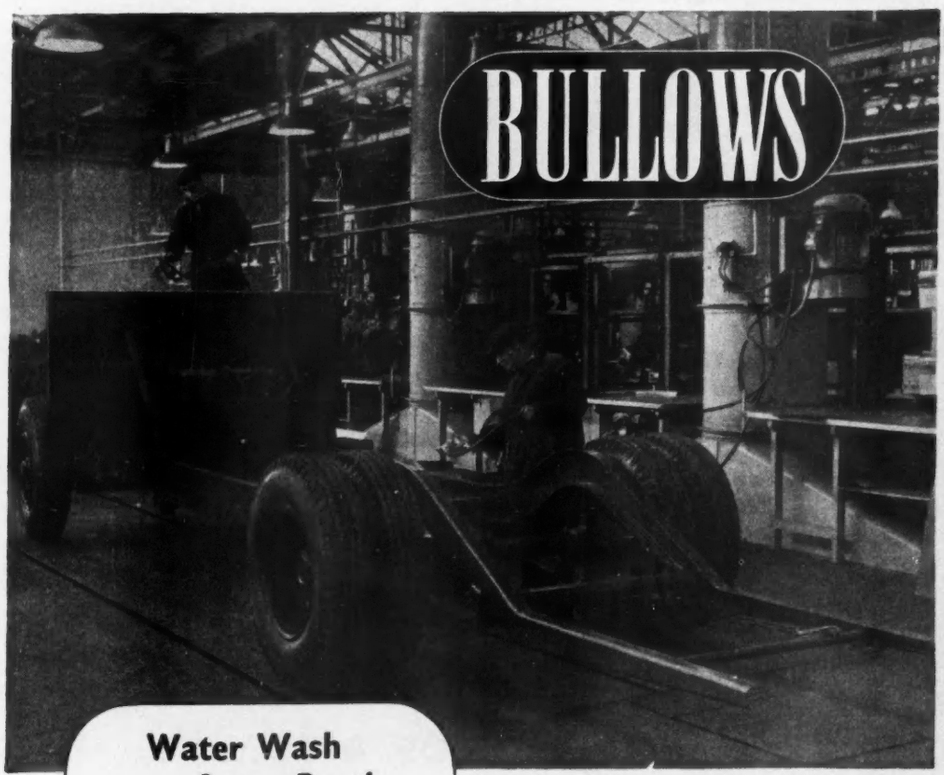


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